The Chemical Age

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NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Other communications relating to advertisements or general matters should be addressed to the Manager.

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Ringing the Changes

THE Society of Chemical Industry seems in many ways to be in a state of flux, and it is not too much to say that its future depends to a very large extent upon a sound financial and domestic policy and upon leadership of the highest order. The announcement that Mr. John Gray will be unable to continue as President of the Society for the normal second year of office is therefore a heavy blow, and in view of the magnitude and responsibility of the task which lies before his successor it is perhaps not surprising that the name of the President-elect could not be announced simultaneously with the news of Mr. Gray's retirement. In this connection it must be remembered that it was proposed to hold the annual meeting of the Society next year in Canada, and in the anxious times through which the Chemical Industry is passing, a lengthy visit abroad entails considerable self-sacrifice if viewed in conjunction with the onerous duties of President. In all the circumstances it might be a wise decision to postpone the annual meeting in Canada until such time as the Society's house is again in order, and to concentrate upon the wise and progressive policy initiated by Mr. Gray and already noticed in these columns.

The retirement of Dr. Stephen Miall from the secretaryship of the London Section will also be universally regretted, though his services on the Council will still be retained in his capacity of Vice-President elect. In this case there is, however, the compensation that his tact and energy will be adequately utilised by the Federal Council of Scientific Societies. Mr. Julian L. Baker's eulogy in presenting silver bowls to Dr. Miall and to Dr. Charles A. Keane at last Monday's meeting of the London Section did not overstate the debt which the Society owes to their unselfish and untiring activities in making the last annual meeting a thorough success. Dr. Keane in his reply struck the right chord in asking for constructive suggestions as distinct from destructive criticism, and it is to be hoped that these will be forthcoming in full measure and will receive due consideration. In the inner working of a Society it often happens that such suggestions are lightly rejected in the first instance, only to be revived and put into practice when it is nearly too late. We look forward to a comprehensive and carefully planned financial policy under the ægis of Mr. E. V. Evans, the new Treasurer of the Society, an office which literally holds the key to the whole situation. The appointment of Professor Louis as the Honorary Foreign Secretary is an admirable choice, and his international reputation and connections should be of the greatest assistance in cementing the cordial relations and the spirit of mutual co-operation with the chemists and technologists of our Allies which were initiated last year. It is not for us to make any suggestions in regard to the choice of the new President, but it cannot be too often remembered by those concerned that the future of the Society and of the Industry as a whole very largely depends upon the choice made and upon the measure in which the new President takes advantage of the unique opportunity afforded to make good. As one speaker on Monday, inadvertently dropping into a Spoonerism, put it, "the complex is a very problem one"!

Nitrogen Fixation Plants

IF in the past too little attention has been given to the problem of nitrogen fixation the tendency would now appear to be in the opposite direction. It is clear that if every nation of any size is to provide itself with its own installations so as to be independent of natural supplies of nitrate from Chile it will necessitate, pending the outbreak of another world war, an

enormous extension of existing markets to absorb the product as a fertiliser. And nearly every nation appears to be contemplating such provision, if it is not actually engaged in making it. Outside Germany, which was the first nation to become self-dependent, France, Switzerland, Italy, Norway and Sweden, the United States, Japan, and even Russia have all in view some method or another of supplying their needs in this respect. In this country not only have we two very large installations directly in prospect, but supplementary provision is contemplated in various parts of the Empire where the necessary volume of water power is available—Canada, New Zealand, Assuan (Egypt), and Mysore (India). The explanation of all this activity is the determination of each country to make itself self-dependent in the event of war, and the problem as to how far ammonium sulphate can be produced at an economic price takes for the moment a secondary place. It is true that £6 per metric ton of (Haber) ammonium sulphate, the figure suggested by the Nitrogen Products Committee, shows a substantial margin as compared with the pre-war market price of £13 6s. per metric ton, but allowing for the heavy initial expenditure on plant and experiments, there can be no immediate hope of any very generous return on the outlay.

As regards this country, the two schemes now before the public should satisfy all reasonable national requirements, if indeed they do not exceed them. That of the Cumberland Coal Power and Chemicals, Ltd., of which an account was given last week, must now be seriously reckoned with. This week, we believe, representatives of the company are in France in connection with the arrangements, and there is every disposition, so far as we can learn, to put the proposals outlined into practice without any unnecessary delay. Side by side with this comes the official announcement of the sale of the Government factory site at Billingham to a syndicate consisting of Brunner, Mond & Co., Ltd., and Explosives Trades, Ltd. A company will be formed to take over and work the synthetic ammonia process, and the names of the first board of directors will be submitted for the approval of the Government. All outstanding liabilities of the Ministry of Munitions in connection with the project are to be taken over.

A full history of the establishment of the Billingham works would be of great interest, but if such a document is in existence it is not likely to see the light. The factory was begun, as is well known, early in 1918 with a view to supplementing the country's munition resources, and was designed for the manufacture of synthetic ammonia from the nitrogen of the air and the production of ammonium nitrate on a large scale. When the constructional work was stopped after the signature of the Armistice we believe that the plans for the factory itself were in a very incomplete state. The purely chemical processes, it is understood, had been satisfactorily mastered, but the weak point was the engineering side, and it was not until the work of German chemical engineers had been inspected that a way was seen to make the defects good. It may be assumed now, with so powerful a corporation in possession, that the plant, processes and general organisation will be second to none in any part of the world. The new company will, of course, have the benefit of the research work carried out on behalf of the Government, and the claim that in many directions the plant will represent a substantial advance on anything previously used in Germany is no doubt well founded.

While, therefore, the future needs of this country are in process of being adequately provided for, our friends in the United States are considerably divided in opinion as to the future of their war-time plants established at Muscle Shoals. An enquiry is now proceeding into the proposed transfer of the property to a United States corporation, and already objection is being taken on behalf of existing interests, particularly the American Cyanamid Company. One of the points raised is that there is no place in the present market for the products expected to be turned out at Muscle Shoals, and Dr. W. S. Landis, the chief technologist to the company, bases his opposition on three main grounds—that existing corporations will be unfairly handicapped in competition with the Government, that Government operations will prejudice business which private companies have developed at considerable expense, and that continuation of the Government plant as proposed will involve an appropriation of processes and patents belonging to private interests. Such problems as these, of course, are bound to arise where State interests have to be considered before private interests, and as regards outlook the only way of absorbing enormously increased production throughout the world will be a corresponding expansion in the employment of chemical fertilisers for increasing the world's supply of foodstuffs.

The Petrol Problem

Dr. ORMANDY, in his second article in *The Observer* on the petrol problem, regards power alcohol as the only substitute seriously worth consideration, the alternatives being nothing more than palliatives. The most obvious substitute, he points out, is benzol, but as a ton of coal distilled in a gasworks produces about ten gallons of tar, and a ton of tar yields 1-2 gallons of motor benzol, the total production of motor spirit from gasworks can only amount to a few million gallons at the outside. Nor does the scrubbing and distillation process, which was employed during the war, for the recovery of benzol from gas promise more than a comparatively fractional improvement of yield, and the same conclusion is reached regarding low temperature distillation. The only other liquid which has ever been seriously considered as a competitor to petrol is alcohol, and the question of its supply in adequate quantities Dr. Ormandy regards as an Empire problem. The recent experiments of Mr. Bury at Skinningrove, he points out, demonstrated that alcohol can be obtained from ethylene contained in coke oven gases at a price which would render the matter worthy of immediate and close consideration. If all the coke ovens in this country were arranged for the conversion of the ethylene into alcohol, over 50 million gallons of this fuel would become available, but large though this amount may appear, it is negligible compared with the demands which are likely to arise in the next decade, and, like the coke oven benzol, the amount is limited and regulated by the growth

of the iron and steel trades in this country. The real remedy, therefore, lies in the enormously increased cultivation of crops which supply the main sources of alcohol—sugar and starch. As an example he claims that a ton of maize will produce about 80 gallons of power alcohol, and before the war there were districts where maize could be produced at £1 a ton. He concludes that there is no reason why power alcohol should not be produced by the systematic growth of suitable crops in suitable areas. It has been demonstrated that alcohol mixed with benzol can be used with complete success on existing motors with little or no alteration beyond the provision of warmed air to the carburettor. Mixtures of alcohol, benzol, and petrol can be made which would permit of hundreds of millions of gallons of alcohol being absorbed in the world's motor spirit market. Should the time arrive when the bodies required to mix with the alcohol are no longer available, part of the alcohol can be converted into ether and the mixture of alcohol and ether used for power purposes, as it is being used in South Africa, and will shortly be used in India and Australia. Researches, he adds, into approved steels and superior alloys for motor construction are no doubt valuable and desirable, but at the moment it would seem wiser if everyone concerned were to concentrate on the fuel position, and with regard to this there is ample scope for research in many directions.

Condenser Tube Corrosion

THE Corrosion Research Committee of the Institute of Metals are issuing an appeal to which we are glad to give publicity in support of the important research work they are carrying out with the object of preventing corrosion generally, and in particular that of condenser tubes—a matter closely affecting the regular, safe, and economical running of steamships. This work has been in progress for ten years, and has been financed first by the Institute of Metals alone, and later by the Institute in conjunction with makers of tubes, makers of condensers, and the Government Department of Scientific and Industrial Research. In a communication to the Corrosion Research Committee in regard of their contribution for 1919-20, the Department drew attention to the fact that the users of tubes and condensers contribute nothing to the cost of the research work. The Advisory Council strongly hold the view that since this research is of great value to the users, an effort should be made to secure financial aid from them as well as from the makers, and to encourage this they offer that for every £1 contributed by the users the Government will contribute a like amount. The makers, it is stated, are already contributing nearly £1,000 per annum, and it is suggested that the users who derive so much advantage from the work carried on should recognise this fact by making at least an equal contribution. As an example of the good results already secured, it is stated that a process has been discovered by the committee's investigator after prolonged and costly researches, which is being tried on a practical scale on one of H.M. ships. The results so far are reported to be entirely satisfactory, and if the final result is the same it will lead to an immense saving by all users of condensers. Since the makers have already voluntarily recognised the claims of the committee to a financial subsidy it would seem difficult for the users, who benefit to quite an equal if not greater extent, to ignore the obligation.

Powdered and Mixed Fuel Trials

MR. J. G. ROBINSON, chief mechanical engineer of the Great Central Railway Company, has just announced the results of some interesting experiments with two new forms of fuel for railway locomotives, namely, pulverised low-grade coal and a mixture consisting of 60 per cent. pulverised coal and 40 per cent. of low-grade oil. For the purpose of his experiments Mr. Robinson designed a new type of burner, and the results proved so satisfactory that he decided to test three engines of the same class—eight-wheel coupled mineral train engines—in order to ascertain the comparative effects obtained with bituminous coal, with powdered coal, and with the coal and oil mixture. The test selected was a non-stop run with 80 wagons from Manchester to Dunford through the Woodhead tunnel. This covered a distance of 20 miles with a ruling gradient of one in 120, and all who know that section of the line will agree that it constitutes one of the most severe tests an engine could be subjected to.

The result of these trial runs was to show that the locomotives burning the pulverised coal and the oil mixture worked the train exactly in the same time as the locomotive using bituminous coal, with a full head of steam the whole distance. Only a thin grey smoke came from the locomotives using the new fuels, showing thorough combustion, while the thick black smoke from the ordinary coal could be seen from a long distance. Apart from these important results there were no ashes from the locomotive using the mixture. So satisfied is Mr. Robinson with the results already attained that he proposes to continue his experiments on all kinds of fuel, and he declares himself quite prepared on the basis of his recent tests to run a train on the new fuels between Manchester and London. A pulverising plant has been erected at Gorton, by means of which a variety of materials can be converted into engine fuel. Many engineers from foreign countries have already been to Gorton to inspect the plant and to learn the result of the experiments already conducted, and it is quite reasonable to hope for new knowledge which may have an important bearing on the more effective and economical use of our available fuel resources.

The Calendar

May 10	Biochemical Society. 5.30 p.m. ...	St. Bartholomew's Hospital (Chemical Dept.), London
13	Royal Society: Election of Fellows. Papers by Dr. A. D. Waller; W. N. F. Woodland; Prof. A. Keith. 4 p.m.	Burlington House, Piccadilly, London.
14	Iron and Steel Institute: Final Session of Annual Meeting. 3 p.m.	Mappin Hall, Sheffield.
14	Physical Society of London: Papers by Dr. F. Lloyd Hopwood; G. D. West; A. Campbell; T. Smith. 5 p.m.	Imperial College of Science, Imperial Institute Road, South Kensington, London.
June 1-2-3	The Institution of Gas Engineers Annual General Meeting	39, Victoria Street, Westminster, London.

Fire Dangers in Factories and their Causes.—II

By T. H. Gant, A.R.C.S.(Lond.), A.I.C.

The experience of the author as Danger Building Officer at H.M. Factory, Gretna, gives exceptional weight to this article, which is continued and completed in his issue. While the conditions at such great works as Gretna, especially during the progress of the war, are not normal, the study of the whole problem of fire dangers is of general application to practically all works involving the employment of chemical processes and materials. Mr. Gant's notes on the subject were originally communicated to the Scientific Society of H.M. Factory at Gretna, and the numerous applications for copies suggest that their publication in complete form will be widely appreciated.

Fibrous Materials

A subject which offers considerable interest and which, as a rule, is rather lightly dismissed, is that of the risks attaching to fibrous materials, more especially when they are impregnated with oil or fats. The fire risk of these materials depends chiefly on their behaviour towards heat, fire, wet, electricity, oils and fats, and acids or other chemical reagents.

Fibres of animal origin such as those of wool and silk are much less dangerous than those of a vegetable origin. This is chiefly due to their solid structure, and freedom from cavities. Vegetable fibres, on the other hand, such as those of cotton, jute and hemp, are hollow or cellular in structure, and far more dangerous than solid ones inasmuch as the cells become filled with oxygen or highly oxygenated substances, and so further the oxidation of any organic substance with which the fibre is contaminated. Combustion of the fibre is thus facilitated and the spread of the flame is more rapid. In this respect, hollow fibres with large cells or cavities are also more dangerous than those with small ones.

Cotton is found to exhibit the largest cavities whilst nettle fibre which is used in the manufacture of cloth has the smallest. The higher the temperature a fibre will stand without any appreciable loss other than that of mositure, the smaller its fire risk. This maximum temperature in the case of silk is 250-350°F., wool 230°F., cotton 220°F.; whilst other vegetable fibres show decomposition at temperature between 212-221°F.

From these temperatures it will be observed that the animal fibres exhibit less risk than vegetable, but on the other hand they retain heat in a much more tenacious manner. As the curves indicate, the order is reversed. These curves have been arrived at by taking three equal sized balls of silk, cotton and wool, and uniformly heating them to a temperature of 208·4°F., and then noting their rate of cooling.

Silk shows the greater retention of heat, the amount radiated during the first 10 minutes being only 20·4 per cent., whereas wool loses 35·7 per cent., and cotton 46·9 per cent. It will thus be seen that when the storage in bulk of these materials is concerned, the rate of radiation or conduction is an important matter. Silk may be said to be the least dangerous of all fibres and may contain from 10-30 per cent. of natural moisture which is not all expelled until a temperature of 248°F. is reached.

Contrary to what one would expect, the presence of moisture under some circumstances increases the risk of fire; this is particularly the case with the fibres simultaneously subjected to heavy pressure, as in the case of jute nitre bags, the two factors increasing the power of retaining heat.

Cotton is the most dangerous of all fibres as it contains the largest cells, and so has a greater air content. When heated, slight browning takes place at a temperature of 220°F., browning being considerable at 320°F., and charring practically complete at 446°F. Minute sparks caused by striking the iron binding hoops of the bales have been known to ignite cotton.

In some cases of spontaneous ignition of cotton, the fibre would appear to act as a catalyst and this phenomenon may be best illustrated by dipping some cotton in ether, opening it out, and after allowing the bulk of the ether to evaporate, gently warming it on a hot plate. In a few seconds the fibres will be found to become surrounded with a blue aureole exhibiting a bluish luminosity in the dark. Aldehydic vapours will at the same time be evolved. If the application of warmth be continued, the mass will ignite. This action can be best explained by the catalytic action of the fibre in condensing atmospheric oxygen in the pores bringing about the decomposition of the ether. The ignition of cotton waste saturated with turpentine is said to be brought about in a similar manner, ozone being first formed.

The risk of fire due to fibrous materials coming into contact with oils or fats must be regarded as a very serious one, whereas neither the oils, fats or such like substances on the one hand, nor the pure fibres on the other, are liable to ignite of their own accord; they incur this risk as soon as they are brought into intimate contact. Of the fibres which are most dangerous in this respect and are liable to undergo spontaneous ignition are flax, hemp and jute, these being much more dangerous than cotton. When in a thoroughly dry condition and under the influence of moderate warmth, such as from a radiator, or from the sun, if stored close under a roof, pyrophoric carbon is formed, and an outbreak of fire is liable to occur.

The tow from jute is especially dangerous, as it will glimmer at a temperature as low as 257°F. and is easily kindled. A case is on record in which a pile of tow, whilst showing no signs of burning on the exterior, was found to be completely carbonised in the interior, and an outbreak of fire occurred almost immediately.

My attention has recently been drawn to other cases of the carbonisation of tow from jute Nitre bags, which occurred at a bag-washing plant. In one case the fan of a mechanical dryer was installed in such a careless manner that it rotated in the wrong direction, and, instead of the hot air being forced over the steam radiators on to the bags being dried, the air was first sucked over the bags and on to the radiator with the result that the radiators became embedded in tow from the bags and the tow carbonised. It was only by the timely discovery of this that an outbreak of fire was averted.

An instance of an outbreak of fire due to friction occurred at the same plant. A centrifugal wringer had been loaded with newly washed bags, the corner of one of which overlapped the basket; when the basket was spinning the corner of the bag was cut off by friction with the outer basket of the centrifugal, ignited, and thrown on to another bag lying some distance away which was also ignited.

The risk of spontaneous combustion is due to the absorption of oil in the cells of the fibres. The oil is disseminated over a large superficial area, and so exposed to the action of atmospheric oxygen, whereby the oil which is spread out in an extremely thin layer in the cells becomes oxidised and laden with gas. This process is really one of auto-oxidation, the fibres acting as a carrier of oxygen, rendering it more active, and goes on in every pore of the fibre; since these reactions are concurrent a considerable amount of heat is developed in a short time, which, except

under favourable conditions, cannot excape and so gives rise to the ultimate combustion of the oil in the fibre.

Kissling carried out an experiment with linseed oil and cotton. He treated 50 grammes of cotton with the oil, and noted the rise in temperature over a period of 15 hours, at which time the cotton ignited spontaneously :—

Temperature.	Hours.
23·5°C.	1
23·8°C.	2
23·8°C.	3
24·5°C.	4
25·0°C.	5
25·0°C.	6
26·0°C.	7
26·5°C.	8
28·0°C.	9
30·0°C.	10
32·0°C.	11
45·0°C.	12
94·0°C.	13
125·0°C.	14
170·0°C.	15

It will be noted that the temperature rose very rapidly towards the end of the experiment. Kissling also found that fibres, soaked with linseed oil and exposed to direct sunlight for a period of four hours, became heated to a temperature of 266°F., and afterwards took fire, whereas in a similar experiment but sheltered from the sun, the maximum temperature did not exceed 78°F. in the same time. The amount of fat or oil required to produce spontaneous combustion in fibrous materials is small, only about 5 per cent. being required. To increase the amount makes but very little difference even should it rise to 200 per cent.

Almost all fats and oils are subject to auto-oxidation to a greater or less degree, although in some cases no spontaneous heating is produced, but this applies chiefly to mineral oils. The risk of auto-oxidation may be summarised as depending on the following conditions :—

1. The area of the superficial contact between the fat or oil and the air, which in turn depends on the diameter of the cell.
2. The power of the pores to absorb oxygen.
3. The reactivity of the oil with oxygen.
4. Degree of external cooling.
5. Amount of extraneous heat supplied.
6. The degree of acidity or partial oxidation of the oils.
7. The pressure set up in the substance when it is stored in bulk.

From what has been said, it is not difficult to conceive the conditions under which a fire might originate in a cotton bale store. Suppose a piece of waste, contaminated with a low-grade oil finds its way into the middle of the bale, and is then stored. Oxidation of the oil would take place owing to the ready supply of oxygen it would obtain by the capillary action of the fibre. Heat would be generated resulting in carbonisation of the waste. The carbon so formed would absorb any maladorous smell given off until such time that the whole burst into flames.

It is found that mineral oils are much less oxidisable than vegetable oils, and may be considered safe under normal conditions. Should, however, the mineral oil be impure, consisting of a heavy oil containing paraffin, and material impregnated with this be hung on steam pipes, or other warm articles, spontaneous ignition of the material may be expected.

Some oils which have been distilled from lignite or coal have a fairly high sulphur content, and such oils should always be regarded with suspicion, as, apart from the danger of heating due to oxidation of the sulphur, when used for the lubrication of machinery, sulphuric acid is formed which has serious effects on the machinery.

Vuaflart has carried out some experiments on the heating of cotton waste when treated with animal and mineral oil. His results are shown in the table :—

Temperature.	Hours.	Mixture.
428°F.	4	Lard oil.
446°F.	6	Neat's foot oil.
226½°F.	6	¾ Neat's foot oil. ½ Mineral oil.
213¾°F.	6	⅔ Neat's foot oil. ⅓ Mineral oil.
213°F.	7	½ Neat's foot oil. ½ Mineral oil.

It will be seen that the addition of mineral oil to neat's foot oil prevented the temperature rising much above 212°F. whereas in the case of pure animal oil it reached a degree as high as 428-446 F. This is an important feature when considering oily rags, cleaning rags, and so on.

Owing to the very divergent character of fibrous materials, it is almost impossible to classify the oils and fats in the order in which they have power of imparting a tendency to spontaneous ignition of the fibre. It is, however, generally assumed that the danger in this connection is in direct ratio to their iodine absorption value, *i.e.*, the amount of iodine absorbed by 100 grammes of fat. A table on this basis is shown, the most dangerous oil in the vegetable and animal classes being placed first in each case :—

Danger of Fats to Ignite Spontaneously in Terms of their Iodine Absorption Value.

Vegetable Fat.	I_2 Value.	Animal Fat.	I_2 Value.
Linseed oil	160–201	Cod liver oil	154–170
Hemp oil	140–157	Seal oil	129–162
Nut oil	136–139	Japan liver oil	100–164
Poppy oil	132–157	Goose fat (domestic)	67–71
"Olein"	100–150	Goose fat (wild)	85–99
Cottonseed oil	100–116	Bone fat	48–68
Sesame oil	102–115	Tallow (beef)	35–47
Rape oil	97–105	Tallow (mutton)	32–46
Ground nut oil	92–100	Wool fat	25–41
Castor oil	81–90	Butter fat	26–38
Olive oil	82–86		
Palm oil	50–57		
Cocoa butter	28–36		
Palm kernel oil	10–17		
Cocoanut oil	8–10		

In the vegetable field, linseed oil is the most dangerous, the danger being increased when it is boiled into varnish.

In the animal field, the fish oils head the list. This brings us to an important point inasmuch as some of the present-day glycerine is manufactured from fish oils, and there is the possibility that traces of these oils may find their way into dynamite glycerine and so give rise to decomposition when it is being nitrated. An explosion which occurred in South Africa within the last few years is said to have been due to this cause.

Although, as shown in the table, animal oils are *less* dangerous than vegetable oils, they are very dangerous when in a rancid condition. Comparative experiments on the time needed for cotton waste to ignite spontaneously when steeped in different oils, are shown in the table :—

Oil.	Time.	Temperature of Ignition.
Linseed	1½ hours	167°F.
Rape	10 hours	...
Olive	6 hours	149°F.
Castor	24 hours	...
Seal	2·4 hours	...
Walrus	4 hours	...

The testing of an oil in order to determine its liability to ignite spontaneously is an easy matter and is carried out as follows: Impregnate 7 grammes of cotton wool with 14 grammes of oil and wrap round the bulb of the thermometer, and place the whole in an iron gauze cylinder and expose to a temperature of exactly 212°F. in a drying oven. If under these circumstances with the temperature of the oven remaining constant, the temperature of the mixture rises to 390°F. within two hours the oil should be discarded as one liable to spontaneous ignition.

It might be mentioned here that the choice of an oil as a lubricant for machinery or pumps is an important matter inasmuch as the temperature of the bearings sometimes rises to 500°F. The kind of lubricant used depends entirely on the type of machinery for which it is required. If a low-grade oil be used for air compressors, there is great risk of the oil cracking in the cylinder, with a lowering of the ignition point and the formation of methane gas. This gas, on mixing with air, forms a dangerous explosive, so that in the event of the breaking down of an oil with consequent ignition there is a danger of blowing out the cylinders and air receivers, it being borne in mind that the air receivers are under pressure and contain a large quantity of oil in suspension. The use of oil as a lubricant for pumps pumping mixed acid is also a matter of great importance. In the early days of this factory an engineer used castor oil as a lubricant, the lubricant was soon nitrated with the result that the nitrated oil blew up the pump. In the choice of a lubricant for heavy running machinery, it should be of such viscosity as to prevent it from being squeezed out of the bearings of the machines on quick-running machinery; and from being expelled by centrifugal force. The lubricant should have a high flashing and burning point to prevent gasification and ignition. The flash point should not be less than 280°C. and the oil should not burn without a wick below this temperature. The flash point for a high pressure should never be less than 550°F. The table shows the flashing and burning point of various oils and lubricants:—

Name of Oil.	Flash Point.	Burning Point.
Olive	419–500°F.	662°F.
Rape	468–581°F.	662°F.
Resin	266°F.	329°F.
Sesame	491°F.	662°F.
Linseed (raw)	480–662°F.	662°F.
		not a lubricant.
Compound lubricating oil	500–608°F.	...
Cylinder oil (mineral)	466–538°F.	565–633°F.
Shale oil (Scotch)	266–356°F.	...
Russian engine oil (dark)	280–320°F.	350–383°F.
Russian engine oil (pale)	325–381°F.	448–457°F.

Inflammable Liquids

In a recent Paper by Payman it is pointed out that the danger to be apprehended during the use of inflammable liquids will depend on the process or processes being employed, which may be divided roughly into three classes:—

1. Those in which the liquids are used for crystallisation, precipitations, or as solvents, or where they are being chemically treated, as in sulphonation and nitration.

2. Processes carried out in drying stoves or rooms in order to remove the liquids from finished chemical products, with or without subsequent recovery of the vapours by condensation or washing.

3. Storage of liquids in tanks and their transfer therefrom to plant or container vessels. Throughout all such operations, and in the manufacture of the liquids themselves, the danger arising from accidental leakage must also be taken into account.

The disastrous explosion which occurred at Silvertown in January, 1917, was due to ignition of vapour in a T.N.T. crystallisation plant, and several explosions have occurred during the stoving of cordite to free it from ether and alcohol.

Payman points out that the two most important criteria for judging the liability of a given liquid to produce dangerous conditions are (1) the volatility of the liquid, (2) the range of explosibility of the vapour when mixed with air.

Each inflammable vapour when mixed with air has a definite range of explosibility. Mixtures containing less than a certain percentage of vapour will not allow the continued propagation of flame, though small ignitions are possible in the neighbourhood of a source of heat of sufficient intensity. If the percentage of vapour be increased, a point is reached when the mixture is again incapable of propagating flame, and a mixture containing a higher percentage of vapour than this is only capable of local ignition. Between these two percentages, known as the lower and upper limits respectively, we have the range of explosive mixtures.

Mixtures of acetone vapour and air are explosive within the range of 2·35 per cent. to 8·5 per cent. acetone vapour. Mixtures of benzol and air within the range of 1·4 per cent. to 4·7 per cent. benzol. Thus, obviously, acetone is more dangerous to deal with than benzol. Ether has a range of 1·8 per cent. to 5·2 per cent. These percentages are by volume, and refer to the downward propagation of flame. The limits observed experimentally differ slightly, as the flame may be helped or retarded according to whether it has to pass upwards or downwards.

A liquid may not be sufficiently volatile at the temperature of use to give a lower limit mixture, and, on the other hand, may be so volatile as to give mixtures which are above the upper limit of inflammability.

Vapourisation Temperature of Alcohol.

Per cent. composition.	Temperature °F.
Absolute	51·0
80·0	68·0
70·0	69·75
60·0	71·5
50·0	75·25
40·0	78·75
30·0	85·0
20·0	97·25
10·0	120·25
5·0	143·5
5·3	Limit of inflammability.

Ignition Temperature of Alcohol.

Per cent. composition.	Temperature °F.
Absolute	Ignites in the cold
60·0	80·5
45·0	87·75

In the latter case the full range of explosive mixtures must, of course, be passed through before the percentage of vapour in the air is sufficiently high to render the mixture safe, and this "safe" mixture may, at any time, become "unsafe" owing to a draught or inward diffusion of additional air if the chamber be opened to the outer atmosphere.

Liquids, such as ether and benzene, must be transmitted to and from storage through metal pipes, and danger may arise owing to the production of electric sparks. Even the faintest electric spark will ignite an explosive mixture of ether, vapour and air.

Fingelberg showed that a single metallic tube continually traversed by ether becomes thereby sufficiently electrified to generate small sparks; and Dolezalek, in 1913, showed that very high potentials may be produced, the nature of the metal used for the tube exerting a great influence. Dolezalek carried out experiments on benzene and ether, using successively pipes constructed of copper, brass, iron, lead and aluminium.

The benzene or ether was forced from a reservoir by means of carbon dioxide under pressure through the coil of pipe to be tested, and allowed to drop into an insulated receptacle connected with an electrostatic voltmeter; the metal pipes were used in the condition in which they are found in practice—*i.e.*, covered with a film of oxide. The experimental results were plotted in curves showing the relation between the velocity of flow in metres per second of the benzene or ether, and electrification produced, using pipes of the different metals.

It was found that, for 90 per cent. benzol, iron is the most dangerous metal, aluminium and lead the least dangerous, and it should be possible to prepare a brass of higher content than normal which will not induce electrification of 90 per cent. benzol. Also, by adding 1 per cent. of 90 per cent. benzol to pure benzene, a liquid is obtained which is not electrified when forced through a brass pipe. For pure benzene lead is the safest metal.

Anhydrous ether becomes electrified much more strongly than moist ether, brass pipes are the safest, and iron ones the most dangerous.

A spark capable of igniting an explosive mixture may be produced by a potential of 300 volts under favourable conditions, but usually 500 to 1,000 volts are necessary. It may be accepted that it is quite safe to force liquids through pipes at velocities capable of developing not more than 500 volts, and the permissible velocities in the case of benzene and ether can be ascertained from the curves (Dolezalek, J.S.C., 1, 1913).

In the case of ether travelling at the rate of 1 metre per second, Dolezalek observed, using a brass pipe, a charge with a potential of 200 volts produced on the ether and using an iron pipe a charge with a potential of 450 volts. With ether travelling at 2 metres per second the corresponding potentials in the case of brass and iron pipes are 500 and 1,250 volts respectively. If a metal receptacle connected with the earth be used to collect the liquid issuing from the pipe, the risk is less, and under such conditions no danger is to be apprehended in the case of ether, but benzene is such a bad conductor that, even with a conductive metal receptacle, dangerous charges may accumulate on the surface, with consequent risk of sparking and ignition of the mixture of vapour and air above the liquid.

One must also consider the possibility of ignition of vapour air mixtures by mechanical means, due to faulty or abnormal working machinery, or the electrification of pulley belting, in contact with the vapours. Sparks may be caused by the grinding of ill-fitting parts or by the overheating of bearings. The heating of these parts might be detected by painting them with pigments that change colour at high temperatures. For instance, a mixture of mercury iodide and copper iodide, which is red at ordinary temperature, turns black at 60°C., the red colour reappearing on cooling.

It can be easily seen that the use of compressed air for moving inflammable vapours from vessel to vessel is attended with great danger. In its place, compressed flue gas, nitrogen, carbon dioxide or other "inert" gases may be used, as risk of explosion is absent if there be insufficient oxygen in the atmosphere in contact with the liquid.

Burgess and Wheeler showed in 1914 that if the oxygen content of air is reduced below 13·25 per cent. no mixture of methane with such an atmosphere is capable of propagating flame. Several patents have been taken out dealing with the use of inert gases for transferring and storing inflammable liquids.

Other Risks in the Use of Ether

I will now deal more fully with risks which may arise in the use of ether other than those due to electrification, faulty working of machinery and consequent danger of ignition of mixtures of ether, vapour and air. To appreciate these risks completely it is necessary to understand the chemistry of ether and of its manufacture.

Ether does not ignite or explode spontaneously, though circumstances may arise under which it acquires a tendency to explode with violence. Exposure to air or direct sunlight for prolonged periods results in partial oxidation, with formation of divinyl ether and hydrogen peroxide. Nef showed that ether oxidises slowly in air in presence of light, and also in the dark at 260°C., or by contact with heated metals, such as platinum, copper and iron. Legler examined the products of combustion at the higher temperature, and found, amongst other things, acetic acid, aldehyde and formic acid. Richardson showed that dry ether, under the influence of light, slowly oxidises, forming aldehyde, acetic acid and hydrogen peroxide. In the presence of ozone an explosive compound is formed, which was first investigated by Berthelot, and called by him ethyl peroxide.

The formation of an explosive substance is also observed when ether is kept stored for a long period, and Pollock and Thurnmell have demonstrated the formation of what they describe as vinyl alcohol, but what is in reality divinyl ether.

$$CH_2{=}CH{-}O{-}CH{=}CH_2.$$

The ethyl peroxide of Berthelot was investigated by Harries, who obtained it by leading ozone into strongly cooled ether, and was found by him to be very explosive and a strong oxidising agent.

The explosions which have been observed during the evaporation of old ether residues, either alone or in contact with organic substances, are due to the decomposition of ethyl peroxide which accumulated in the residues on account of its higher boiling point. The alcohol used in the manufacture of ether contains amyl alcohol, and possibly small quantities of higher homologues. By heating alcohol with sulphuric acid, a certain amount of ethylene may be formed according to Williamson's reaction. Thus

$$C_2H_5{-}\frac{OH}{C_2H_4}+\frac{H_2SO_4}{H_2SO_4}\,C_2H_5{-}O{-}SO_3H \text{ Heat.}$$

Very possibly no appreciable quantity of ethylene is formed during the manufacture of ether; but it seems very probable that small amounts of higher members of the olefine series of polymers of them are formed in this way from the small quantities of higher alcohols present.

Enough has been said to indicate that in ether recovery systems we have ideal conditions for oxidation of ether—*i.e.*, ether in a warm atomised condition mixed with a good supply of air in contact with metals in the vapour ducts leading to the scrubbers. Seeing that nitroglycerine is partially vapourised at the temperature of stoving (110°F.–115°F.), it is fairly clear that dangerous bodies such as ethyl nitrite or nitrate may be formed. Ethyl nitrite will explode spontaneously at 75°C. when in contact with a fat or organic matter. The nitrate, although more stable, will explode at 87°C. Moreover, the cresol of the scrubbers is a reactive body, and decompositions would surely occur if the ether contained any olefinic bodies.

Summary

Ether may contain, in addition to water and alcohol, aldehyde, acetic acid, olefines, divinyl ether, ethyl peroxide and hydrogen peroxide, to other bodies which may result from the action of these upon one another. Recovered ether may contain all these, and in addition "oresylates," resulting from the reaction of portions of the impurities with cresol and ethyl nitrite and nitrate, or higher homologues. These impurities, some of which are strong oxidising agents, and themselves unstable, may, if present, cause decomposition in the cordite, for whose manufacture the ether is used, and very probably such decomposition has led to the serious explosions which have occurred during

the stoving of cordite in various parts of the country. To conclude this subject: We have seen that when ether traverses a metal pipe both it and the pipe becomes electrified. The pipe and all metal connected with it will remain in this condition for some time if not well earthed, and, even if the ether is run into a metal receiver, it will, if sufficiently dry, retain its charge. This will produce an electric strain in the air above the ether, and this may surely ozonise some of this air, and then in turn reacts with the ether. Harries has shown how easily ozone reacts with ether to produce ethyl peroxide, so here we see how possibly peroxides may originate in ether of comparatively recent manufacture.

Hydrogen peroxide may be formed as a result of the reaction of some of the ethyl-peroxide with a little water present.

In the event of an outbreak of fire, care must be taken that the measures adopted in order to extinguish it do not lead to a worse conflagration and extension of flame.

In some cases the employment of water may be dangerous, and its use should be prohibited or employed with the greatest caution where it may favour the progress of chemical reaction or assist the spreading of burning substances lighter than and immiscible with water, or where it may effect the liberation of dust.

Water reacts vigorously with oleum, and with carbides the highly explosive gases acetylene and methane are evolved. Molten sodium nitrate will decompose water into its constituents, giving rise to explosions of oxyhydrogen gas.

Water should not be used to extinguish ether, benzene and petroleum, or other such like substances, as the burning liquid floats on the water and spreads the flame to other parts. Sand or earth should be used, and where the conflagration takes place in tanks the covers should be put on.

A steam installation would extinguish a fire in any building except where it entered in chemical combination, as where it might play on glowing ironwork at a temperature of 680°C.–1,000°C., a temperature sufficiently high to decompose steam into its constituents, and so give rise to oxyhydrogen gas explosion.

If certain salts having a high specific heat be dissolved in water, the usefulness of the water is augmented. These salts have a dual effect as an incombustible incrustration on the surface of the burning substance. Some of them also give off heavy incombustible vapours, such as CO_2, NH_3 and SO_2.

Sodium silicate is sometimes used in solution with water. Chloride of Ca, Na and Mg are also used, but offer the objection that Cl_2 and HC_1 gases are given off which makes them objectionable when dealing with fires in confined places.

The various chemical fire extinguishers can only be used in closed rooms where the antipyrene gases cannot be dissipated. Care should be taken in choosing fire extinguishers, since some of them have been known to contain nitrates, and actually to assist the flame.

Two types of chemical fire extinguishers are used in this factory. The first is based on the evolution of CO_2, and the second on the formation of other heavy incombustible vapours. The CO_2 generator type contains a solution of carbonate and a phial containing sulphuric acid. These two on mixing together form CO_2, which is forced out under considerable pressure, which may attain six atmospheres.

This type of generator has the disadvantage of being liable to get out of order, for if the water evaporates or too strong a solution of carbonate be used, crystallisation of the salt may take place, and so the mouth of the apparatus be choked, with the result that it may fall at the crucial moment, burst, and injure the user. It is also necessary to keep it warm to avoid freezing of the water.

The second type would appear to consist of a mixture of chloroform and carbon tetrachloride. This type depends on furnishing a heavy incombustible vapour round the seat of the flame, and so preventing access of oxygen.

The best fire extinguishers are those of a gaseous character, such as CO_2, SO_2 and NH_3. They have the advantage of being obtainable in a liquid form, and by means of pipes could be led to the seat of a fire.

SO_2 and NH_3 are unsafe, because of the suffocating character when in the gaseous form, and should only be used by an expert.

The following table shows the percentage of CO_2 in ordinary air required to extinguish the flames from various oils and gases :—

Flame	% CO_2
Marsh gas	10%
Paraffin oil	15%
Rape oil	16%
Carbon monoxide	24%
Coal gas	33%
Hydrogen gas...	58%

United Premier Oil and Cake

THE annual meeting of the United Premier Oil and Cake Co., which holds practically all the capital in Wray, Sanderson & Co., J. L. Seaton & Co., Premier Oil Extracting Mills, Sowerby & Co. Ltd., and the Universal Oil Co., Ltd., was held in London, on Friday, April 30.

Mr. Herbert Guedalla (Chairman), who presided, in moving the adoption of the report and accounts said that the company started operations in May 13, 1919, and therefore the report covered a period of only about 7½ months, and he thought they were entitled to congratulation on the results shown. A research department had been established, and they hoped that this would not only lead to developments in their own particular business, but also would enable them if they thought fit to take interests in kindred businesses which utilised the material which they manufactured. Their particular trade had been passing through a prosperous period, and it was in times like these that they felt that they should be prepared to consider development in different directions where such development was a legitimate extension of business. At the date of the balance-sheet they had a stock of material representing a value of £70,058. Since that date they had decided that it was not in the interests of the subsidiary companies that their company should deal in raw material, and this branch of business had now been definitely closed down.

The directors had decided to increase the capital of the company by the issue of the unissued 250,000 Ordinary shares at the price of 25s. each in the proportion of one share for every two shares held by each Ordinary shareholder. When this company was formed the subsidiary companies possessed a net working capital of about £480,000. Since that date, as in all other industries, the price of raw material and other expenditure had risen considerably. Even to do the same amount of trade as in the past, it had become obvious that in order to meet this increased expenditure further working capital was required, but they intended to go further than this, and were going in for various extensions and the acquisition of interests in kindred businesses. To ensure the success of the issue in these difficult times they had deemed it necessary to have the issue guaranteed for a consideration of 1s. per share by the Imperial and Foreign Corporation, Ltd., and this amount had again been sub-guaranteed with various parties. The company would thus receive a net amount of 24s. a share, so that they would get an amount of £300,000 in all, and would possess a premium reserve account of £50,000. The new shares when fully paid would rank *pari passu* with the present Ordinary shares as from January 1, last in respect of all dividends declared subsequent to the final dividend, which the company were declaring at this meeting.

A final dividend of 5 per cent., free of income tax, was declared on the issued ordinary shares, payable on May 15, making with the dividend on like amount on December 15, 1919, 10 per cent., free of income tax, for the period ended December 31, 1919.

Debittered Dried Yeast

By Louis J. Riley, F.I.C.

AN investigation was carried out during the war with a brewery by-product—dried yeast—which prior to hostilities had been mainly exported to Germany, and at the time was solely of interest, in this country at any rate, as cattle food; and even this to a restricted extent, owing to its marked bitterness (see *Journ.* Board Agric., No. 1, 1915, pp. 1 *et seq.*, also *Journ. Inst. Brewing*, 1918, pp. 320-1).

It has been recognised that, apart from the question of nutritive value *per se*, dried yeast would possess good digestion and assimilation-promoting value in virtue of its known substantial amido-acids content, which would make for good economy. The richness of yeast in vitamines lends additional interest and prompts enquiry as to how far the drying and the debittering process affects these bodies.

At the time of this investigation the production of yeast for human food was being carried out on a large scale in Germany. This yeast was being specially produced for the purpose, and it is stated that debittered yeast had resulted in a product with unsatisfactory flavour (*Hayduck, Polytech. Ges.*, Berlin, Nov. 18, 1915. *Z. angew. Chem.*, 1915, 28 *Wirtscheft Tl.* 697-9).

Appparently the method generally employed for debittering consists essentially of washing the yeast, substantially as obtained at the brewery, with water containing alkali. All methods proposed hitherto involved treating the yeast substantially in the condition in which it is obtained at the brewery.

The investigation has revealed that *dried* yeast can be completely debittered and a product with good flavour obtained by the process of extracting repeatedly with a hot mixture of alcohol and water, which can be most conveniently carried out in an extractor based on the principles obtaining in the Soxhlet apparatus, whereby a minimum amount of solvent is employed for extraction automatically, and the solvent is finally recoverable almost automatically by the same operation which dries, *in situ*, the debittered product.

Alcohol by itself is ineffectual, as can be proved by substituting absolute alcohol for the mixture. Whereas, on the one hand, a higher ratio of water makes for cheaper solvent and greater extraction, on the other, the higher the proportion of alcohol the quicker the rate of extraction and the higher the yield of the product. A high content of alcohol also maintains the porosity of the material, but a larger amount of water tends to plasticity. A mixture of alcohol and water in the proportion (by vol.) of 80 to 90 parts of alcohol to form 10 to 20 parts of water yields the best results—everything considered.

Neither methylated nor industrial spirit can be employed, for the yeast absorbs some of the evil-smelling and tasting constituents resulting in a nauseous product. Experiment has shown that 5 per cent. or more of methyl alcohol, which is quite free from objectionable odour, may be substituted for a corresponding amount of alcohol in the above mixture, whereby, it is believed, in view of the toxic nature and difficulty of removal of the methyl alcohol, that provision has been made for securing duty-free solvent, owing to the latitude allowable by the Excise authorities in special cases (see *Journ. Society of Chem. Industry*, 1914, p. 880). The thoroughly dried product is quite free from methyl alcohol, as ascertained by a very delicate test (Denigè's).

Dried yeast meal, as produced by the efficient plant in use, lends itself readily to the extraction, in virtue of its friable and porous nature.

Yield (Laboratory) of Products

A dried yeast with content of 8·55 per cent. nitrogen and 6·42 per cent. phosphoric anhydride, submitted to the process, gave :—

Debittered product ...	83·50	containing 8·36 per cent. nitrogen and 6·30 per cent. phosphoric anhydride.
Resinous material extracted (by-product).	16·50	
	100·00	

This shows that the nitrogen and phosphoric anhydride percentages remain substantially the same as a result of debittering by the process.

In view of the known similarity between yeast and meat extracts, in recording the proportion of soluble and insoluble matter, with nitrogen content, in the above yield of debittered product, the corresponding figures obtained with pure powdered beef are also given :—

THE DEBITTERED YEAST.

			Parts. Nitrogen.		
Soluble	33·61	containing	2·29 (=6·81%)	Proteose N.	0·44
				Peptone N.	0·48
				Basic* N.	1·37
					2·29
Insoluble*	66·39	,,	6·07 (=9·14%)		
	100·00	,,	8·36		

Phosphoric anhydride=6·30%.

PURE POWDERED BEEF.

			Parts. Nitrogen.		
Soluble	10·37	containing	1·06 (=10·22%)	Proteose N.	0·17
				Peptone N.	0·34
				Basic* N.	0·55
					1·06
Insoluble*	89·63	,,	12·80 (=14·28%)		
	100·00	,,	13·86		

Phosphoric anhydride=1·11%.

This shows the much larger amount of valuable soluble nitrogenous bodies obtainable from the dried yeast, owing to its very much larger content of soluble matter.

Two large scale (laboratory) extractions of two lots of debittered yeast derived from two distinct samples of dried yeast gave the following yield, respectively, in sums of 1 cwt. of debittered yeast :—

33·5 lb.	of extract	containing	7·17% nitrogen
		and	
37·63 ,,	,,	,,	6·82% ,,
with 70·47 lb.	residue	,,	8·93% ,,
108·10 lb.			

Determination of the nitrogenous bodies in the mixed extracts and, for comparison, in representative yeast and meat extracts, respectively, on the market yielded the following results :—

	Debittered Yeast Extract.	Yeast Extract.	Meat Extract.
	%	%	%
Total Nitrogen	6·82	7·44	9·70
Insol. and Co-agulable matter (expressed in terms of fibre)	0·43	trace	0·33
Proteoses	8·22	9·99	9·52
Peptones	7·59	6·06	8·69
Nitrogenous Bases (factor 3·12)	12·72	14·23	20·15
Ammonia	0·19	0·38	0·34
Phosphoric Anhydride ...	11·62	8·04	6·38

The results illustrate thoroughly that a very large part of the soluble portion of dried yeast is retained in the debittered product resulting from the process.

The nitrogen content of dried yeast varies substantially. Results obtained with different samples are as follow :—

Total Nitrogen.	Soluble Nitrogen.
8·66%	2·26%
8·55%	3·47%
7·42%	2·51%
7·88%	2·00%

All the results in this Paper are expressed on a moisture-free basis.

* Determined by difference.

Reviews

THE USE OF LOW GRADE AND WASTE FUELS FOR POWER GENERATION. By John B. C. Kershaw, F.I.C. Pp. 202. Constable. 17s. net.

The rising cost of all forms of fuel and the possibility of making fuller use of so-called low grade and hitherto despised fuels fully warrants the timely publication of Mr. Kershaw's latest volume on fuel economics. The author's purpose, which is well accomplished, is concisely to indicate ways and means of realising the full potential evaporative or heat value of low-grade fuels which, although often procurable at relatively low cost, are yet unavailable to power users through lack of knowledge of their characteristics and appliances specially designed for their utilisation.

The book is in two sections. Part I. deals with the utilisation for power purposes of peat, lignite, bagasse, wood waste, culm and washery waste, towns' refuse, tar oils, pitch, coke and coke breeze by means of gas producers specially adapted or mechanical stokers. In this section one instance is given and supported by comparative test results of a simple adaptation of the familar chain grate mechanical stoker to use coke, which effects not only a substantial saving in fuel costs, but also an improvement in thermal efficiency of no less than 19 per cent. The impending world shortage of motor spirit imports added interest to the chapters dealing with the utilisation of coke, coke breeze and creosote-pitch mixtures. These fuels are concomitants of coal carbonisation and benzol recovery; and if by-product coking plants are to be extended as it is hoped, the supply of these fuels, which, the author implies, are all capable of being consumed efficiently and smokelessly, should be greatly augmented in the near future.

Part II. is devoted to fuel sampling, testing and buying; calorimetry of liquid, solid and gaseous fuels; the design and management of furnaces and steam boilers with a view to the realisation of high efficiencies; the control of the combustion process and the use of automatic gas-testing apparatus. In his opening chapters Mr. Kershaw directs attention to the growing seriousness of the fuel situation. There are few manufacturers who are not fully alive to the imperative necessity for making the best possible use of the supplies available; and it is to these that the book should appeal. The 52 diagrams and illustrations throughout the book are excellent, and it may be recommended to the student as well as the factory manager and those whose mission it is to reduce to the minimum the fuel cost per unit of production. E. W. L. N.

A FOUNDATION COURSE IN CHEMISTRY (Second Edition). By J. W. Dodgson, B.Sc., A.I.C., and J. Alan Murray, B.Sc. Hodder & Stoughton, London. Pp. 240. 6s. 6d. net.

A first text book of Chemistry should endeavour to inculcate a sound knowledge of fundamental facts and general principles, awakening in the student a desire to build upon a sound foundation a more complete acquaintance with the science, and should avoid burdening him with physical and chemical data not of fundamental importance and not necessary to illustrate the text. This purpose is recognised by the authors and reasonably well kept in view throughout the book. The volume is based upon courses of lectures given by the authors at University College, Reading, to students taking courses in Agriculture, and, in addition to chapters on general principles and on the more commonly occurring inorganic compounds, contains four chapters giving an elementary knowledge of some aliphatic and aromatic compounds. Chapter XIX. deals in an elementary manner with some of the simpler problems in physical chemistry.

The authors have succeeded in producing a volume of value to the student of agriculture, and also to the chemist who wishes to place in the hands of his junior laboratory assistants a book which will give them a useful elementary knowledge of the subject, and which will encourage them to continue systematic studies. The form of expression throughout is simple, and some of the difficulties inherent to the task of writing an elementary text-book are avoided though at times simplicity has been obtained at the cost of technical accuracy. Errors occur in equations on pages 81, 84, and 196. The effect of retort temperature on the composition of coal gas is incorrectly stated on page 133, and a misleading impression of the actual relative monetary values of coal gas and coal tar produced from unit weight of coal is given to the reader on the same page. In point of fact, the relative values are of the order 8 : 1. The paragraph on Cement might be usefully extended while in question 21 the cost of burning lime might be placed at a more practical figure. The solvent properties of water, as quoted on p. 27, are surely slightly exaggerated.

If the volume extends to a third edition—and we hope it will—we would suggest that the authors somewhat revise occasional statements so that the student may not subsequently have to unlearn anything he has read. F. M. P.

INDUSTRIAL ORGANIC ANALYSIS. By P. S. Arup. (2nd edition.) London: Churchill. 12s. 6d. net.

The fact that a new edition of this useful little book has been required is evidence that the author has succeeded in his aim of writing a book which will serve as an introduction to the study of applied organic chemistry. To some extent the title is misleading, since it rather suggests that the book is of a more comprehensive character, whereas it deals only with certain selected industrial products of natural occurrence and their derivatives, and omits many of equal importance. Its scope might, therefore, be enlarged, in future editions. For the most part the subject matter in each section has been brought up to date, and the analytical methods are well chosen and simply described. It would be an improvement, however, if some of the theoretical outlines were given a fuller treatment. For example, the introduction to the section on fatty oils occupies only six pages, and requires a good deal of elaboration to make it quite suitable for anyone who is only beginning to study the subject.

The section which gives the most complete survey of its subject is the final one on preservatives, and this will be found useful to analysts in general practice as well as to students, for whom the book is primarily intended. The value of each section is increased by the addition of a list of references to the literature on its subject, and the index is exceptionally clear. Several illustrations of apparatus are given, but in the case of some of these it would be an improvement if more recent blocks were used. C. A. MITCHELL.

QUANTITATIVE ANALYSIS BY ELECTROLYSIS. By Alexander Classen with the co-operation of H. Cloeren. Revised, re-arranged and enlarged English Edition by William T. Hall. Pp. xiii.+346. John Wiley & Sons; Chapman & Hall, 1919. 17s. 6d.

The general impression that this book gives is that of a thoroughly workmanlike production, which can be relied upon to carry the practitioner in analysis by electrochemical methods from initial conceptions to fully developed technical analysis and to the beginnings of original research. Professor Hall has given full measure of that valued facility for lucid and sympathetic explanation, which sets his book in such grateful contrast with those very numerous productions which merely do admirable justice to the subject treated, whilst causing severe strain on the reader's mental digestion.

The theoretical portion of the book, which occupies less than a third part of the whole, is excellently handled; the remaining two-thirds is taken up with the large number of electro-depositions and separations, which are clearly described, and minutely too, without producing any effect of confusion from excess of detail. It is a violation of custom that the historical portion is not at the beginning, but is placed between the theoretical and practical parts, an arrangement that is successful in its effect. The facts recorded in this section act as a useful corrective to the impression so sedulously aimed at by German books that chemistry is a Teutonic product. Davy, Faraday and Becquerel are more important names than Grotthus, Hittorf and Kohlrausch; while Freudenberg, Exner and A. Fischer are nowise superior to Le Blanc, Edgar Smith, Sand and Perkin.

There is not much on which to comment in matters of detail. Dimethyl glyoxime is not mentioned as a delicate test for traces of nickel; we wonder whether this is due to a desire of the author that inorganic chemistry shall "keep itself to itself," or merely to a very slow migration of facts. It is remarkable that there is so little to record concerning the development in apparatus during, say, the last ten years; it would appear that the maximum of efficiency had been reached, which is unlikely. It is interesting, too, to note that Frary's electro-

magnetic method of stirring the electrolyte, which seemed to be rather a "freak" when first described, has actually been adopted in a technical laboratory.

The general get-up of the book is sound, but we would protest mildly against the character of most of the illustrations, which are curiously old-fashioned. Plate I. (at the end of the volume) shows, in the treatment of its subject, a strong affinity with the wood-cut of the 18th century. We take further exception to the ugly Continental practice of calling attention to a warning word or phrase by means of an exclamation mark. This is quite unnecessary, and most undesirably is slowly appearing in certain English books. The copious references to current literature constitute a valuable index to original papers, but we would have preferred them collected together in the form of a classified bibliography as well as scattered throughout the pages in their proper places. It is not without significance, perhaps, that this work appears to be undergoing the progressive evolution that other translations have followed. It began as a translation of a book by Professor Classen of Aachen; it is now at the stage when the earlier book has undergone considerable independent development by the translator; the final step is for a new book to be produced, entirely dissociated from the old. P. E. S.

THE ENGINEER'S YEAR BOOK FOR 1920. Edited by H. R. Kempe with the collaboration of numerous specialists. London: Crosby Lockwood & Son.

For the past 26 years Mr. H. R. Kempe has endeavoured to supply the engineer with a complete up-to-date library within the space of a single volume. Many, no doubt, would fight shy of such a task, and pronounce it as an attempt at the impossible. Evidently, however, Mr. Kempe does not believe in impossibilities, and the scope and variety of the information which he has crowded into 2,500 pages leaves one full of admiration for the organisation which must have been needed to get so much material together in so accessible a form. Perhaps the only point which strikes the reader is that if the volume continues to grow in size at the present rate—it has increased in bulk by 400 per cent. since the first year of publication—when will finality be reached, and will it not soon be too unwieldy to be classed as a handy *vade mecum*?

The book is by no means one of use to the engineer alone. It should appeal particularly to those who are known by the rather elusive term of chemical engineer, and it should lie on the desk of all who are in charge of works and factories. So far as subjects appertaining to chemical processes are concerned it will be found that there are special sections dealing with Pulverised Coal, by C. L. Harvey; Coal and Metalliferous Mining, by Professor Henry Louis; Gas and Gasworks Practice, by Alwyne Meade; Solid Liquid and Gaseous Fuels, by Harold Moore; Explosives, by Dr. W. R. Hodgkinson; and Clays and Cements, by A. B. Searle. Again, in these days when so much of the technical official's time is occupied by questions of a purely administrative nature, considerable use should be found for the commercial and legal information which the volume contains. C. A.

HANDBOOK TO THE COMMERCIAL REFERENCE LIBRARY (LIVERPOOL).

The practice of establishing commercial reference libraries in the large industrial centres is one to be warmly commended, and this excellent handbook, compiled under the direction of the chief librarian of the City of Liverpool, shows what a useful collection of commercial literature the Liverpool Commercial Reference Library already constitutes. The library was opened on August 1, 1917, with the object of supplying "information of a wide kind" which men may want in connection with their business The library is intended for ready reference to commercial subjects, and the object of the whole scheme of arrangement is to enable quick reference to be made to the contents. The library is situated in the centre of the business portion of the city. The books (which include Government publications, Colonial and other official reports) are placed on open shelves to which the readers have direct access. There is a special rack for periodicals, and attached to it is a carefully compiled index to the principal contents of the current periodicals. By means of that index, business men often find articles on the subjects which interest them, in other periodicals than those they usually read. Back numbers of periodicals are systematically stored, and reference to them can be quickly made. The committee have recognised that in a port like Liverpool there will be a demand for maps, and in that section of the library the latest atlases and maps will be found. By means of a device specially designed for this library, the maps can be quickly placed in convenient positions for consultation. There is a large collection of British and Foreign directories, and the use of these is both extended and facilitated by a card index. The absence of dates from this handbook is intended to imply that the latest issues of all the publications are available.

Atomic Weights and Numbers

To the Editor of THE CHEMICAL AGE

SIR,—I think the suggestion of Mr. J. H. Allworthy, in your issue of the 24th April, will in time be proved to be accurate, and that in due course we shall find that all atomic weights are of the form $2x+a$, where x is the atomic number and a an integer. I should be very grateful to Mr. Allworthy or any other reader for information as to the relation between a and $2x$. The quantity a is originally zero, then 1, and it gradually increases as x increases, but I think only rarely is it much greater than $x/2$. If 7 equal spheres are packed together in the smallest space I fancy 1 would be inside and 6 on the outside, and I have wondered whether the dead-weight in an atom consists of particles in the interior of the atom. Can any reader give me a formula for calculating the maximum number of spheres which will be contained in an outer shell of $2x$ spheres?

According to Mr. Aston, krypton is a mixture of isotopes of atomic weights 78, 80, 82, 83, 84 and 86, and the difference between krypton and bromine evidently depends not on the quantity or the nature of the constituents of the atom, but on their arrangement. The diagrams already published in THE CHEMICAL AGE indicate that the difference between these two elements depends on the fact that bromine has 70 constituents in certain positions, whereas krypton has 72, and that the remaining constituents are stowed away in such positions that chemically they do not matter. Can one squeeze 14 (86—72) equal spheres inside an outer shell consisting of 72 similar spheres?—Yours, &c.,

28, Belsize Grove, N.W. 3. STEPHEN MIALL.

The Royal Institution

THE annual meeting of the Royal Institution was held on Saturday, May 1, Sir James Crichton-Browne, treasurer and vice-president, in the chair. The annual report of the committee of visitors for the year 1919, testifying to the continued prosperity and efficient management of the Institution, was read and adopted, and the report of the Davy Faraday Research Laboratory Committee was also read. Sixty-four new members were elected during the year, and 62 lectures and 19 evening discourses were delivered. The books and pamphlets presented amounted to 193 volumes, making with 399 volumes (including periodicals bound) purchased by the managers, a total of 592 volumes added to the library in the year.

The following were elected as officers for the ensuing year:

President: The Duke of Northumberland.

Treasurer: Sir James Crichton-Browne.

Secretary: Colonel Edmond H. Hills.

Managers: Dr. Horace T. Brown, J. H. Balfour Browne, John Y. Buchanan, W. A. Burdett-Coutts, Sir James J. Dobbie, Dr. J. Dundas Grant, Dr. Donald, W. C. Hood, Earl Iveagh, H. R. Kemp, Sir Ernest Moon, Sir Charles Parsons, Sir James Reid, Sir Ernest Rutherford, Mr. C. Scott-Dickson, Sir Henry Wood.

Visitors: Sir Hugh Bell, Sir William H. Bennett, W. R. Bousfield, John G. Bristow, Frank Clowes, Montague Ellis, W. E. Lawson Johnston, John R. Leeson, Thomas Bell Lightfoot, F. K. McClean, William Smith Norman, Hugh Munro Ross, Joseph Shaw, Thomas H. Sowerby, Sir Almroth Wright.

Two analytical chemists, George Robinson and George Goy, were badly burnt on Wednesday, April 28, by AN EXPLOSION which occurred when they were carrying out some work at the Dean & Chapter Colliery By-Product Laboratory, Ferryhill.

Foreign Dye Patents

Their Bear ng on the Development of a Home Dye Industry

The position of the newly-organised dye industry of America is in many respects analogous to that of the British dye industry. In this article Mr. R. E. Rose, a member of the chemical staff of one of the American dye firms, discusses the bearing of foreign dye patents—more particularly German—on the development of the home dye industry.

DYE manufacturers are faced by one problem which is of the greatest interest to dye consumers and to those interested in chemical patents. The problem is that of improving the line of colours made by extending it to include those newer dyes which the trade has found to possess particularly favourable properties.

Ever since the discovery of synthetic dyes there has been a very keen competition among producers. At first there was piracy and every other form of unfair competition, but soon there came into existence a respect for the protection offered by patent laws; it was a case of self-interest showing this to be the best policy. Once this attitude was adopted the inventor or his assignee enjoyed the exclusive right to a discovery, and it became therefore of the utmost importance to each producer to be able to compete with the invention of a competitor by discovering something either better, as good, or only slightly worse. Of course, there was the possibility of taking the essential of an invention by a rival and modifying it sufficiently in non-essential details to persuade the patent office that the modifications were radical enough to constitute a patentable novelty. This has always been permissible, but the United States and German patent offices have been very difficult to persuade, and have become increasingly so with passing time. In consequence, it has been necessary for a firm to do something really worth while in order to prevent a new field from becoming, in its entirety, the property of a competitor. Naturally this has resulted in a very active working of a field and the consequent issue of a great number of patents. These patents have been the outcome of healthy competition, and they show the excellent effect of patent protection in stimulating chemical research. Those which were not of any value when translated into commercial production were none the less of importance in defining the possibilities and limitations of the discovery. On the other hand, there were a number of patents, taken more particularly in Germany, which were granted to the original inventor, though he knew them to have little or no value. They were to ward off attacks on the essential process by parallel lines—that is, to prevent the issue to competitors of what the Germans called "Umgehungs Patente." These patents added nothing essentially new; they were defensive, not creative.

The Dye Chemists' Problems

The dye chemist soon learns that the dye business is very much more than synthetic organic chemistry. The industry has grown as a result of the interplay of science and art; the growth of the application of dyes has been a spur to the chemist, and the successes of the chemist have widened the possible method of utilising dyes; the inter-relation has been so close that it is often impossible to distinguish between cause and effect. However, in both directions there has been steady progress, and, in consequence, modern methods and recent dyes are usually superior to older ones, though not quite so superior as the introducers of dyes would have their customers believe. It is true, then, that in almost every class of dyes there are some representatives which, because of their properties, such as ease of application, brilliancy, fastness to light, good levelling, are much to be preferred to older ones; these dyes are usually introductions of the last ten or fifteen years. It is these very colours which the consumers of dyes want, and it is these which the industry in this country has found it hardest to produce.

We can divide these new dyes into two large classes: those whose method of production is very nearly exactly known but whose production is so complex that their making it too heavy a task for an infant industry, especially one with an incomplete line of intermediates. The second class is composed of those dyes whose composition is unknown to any but those responsible for their manufacture abroad.

The first class is diminishing in numbers, as is clear from the fact that the most important vat and alizarin dyes are actually being produced, and the beginning having been made, there should be a very quick development.

Regarding the other group, it will perhaps come as a surprise to many to hear that the composition of many of the very best dyes is either entirely unknown to American chemists or is known only in the rough, that is, with insufficient detail to allow of their production without much research. To illustrate, if we take the census of dyes by Dr. Norton we find that in the Azo Group there are 166 classified and 96 unclassified dyes, the latter being those of unknown composition. In justice to ourselves we should point out that English chemists are not ahead of us in this respect.

It should be noticed that members of the second group may be transferred to the first group when their manufacture is understood because it may well be that their constitution is such that it calls for a particular intermediate or intermediates which cannot be made profitably by a dye industry at the stage of evolution reached by ours.

How Patents Affect the Position

This statement brings us back to the subject of patents because it will doubtless occur to many to ask why it is that the composition of these dyes is unknown when practically all dyes are protected by patents and patents are public documents.

A legend has arisen that the German inventors were culprits because they deceived the Patent Office and secured patents which disclosed no real process while affording protection. In reality they used the patent laws to their advantage, but no more so than American firms would have done. Their patents say as little as possible, but they are quite within the terms set by the patent laws of the country. They made their claims as comprehensive as possible, which is what patent attorneys advise; at the same time they covered what they wanted quite securely. The initial failures which met the earlier efforts of dye chemists to substantiate the claims given in German-owned patents were due as much to inexperience as to any faulty disclosure. We should exonerate the Patent Office of the charge that they were deceived by the Germans.

Why then can we not take a patent and read from it the constitution or composition of a dye? Simply because there is nothing to require a manufacturer to state what patent or patents he is using in producing a commercial dyestuff and because a patent may cover a great many possible combinations, only one of which is really utilised.

I need only point out that in a class such as that of the azo dyes, which is subdivided into the great groups of the mordant, direct and acid dyes, the individuals are made from a great many intermediates, and the result is determined not alone by the choice of intermediates which are coupled together, but also by the order of their assembling, or even by the conditions under which they are put together. On the other hand, a great many similar intermediates may be substituted for each other without causing any material change in the resultant molecule.

German and Swiss Pre-War Dyestuffs

The pre-war line of dyestuffs produced in Germany and Switzerland required about four hundred intermediates, the majority of which went into azo dyes. While a great many of these are not "compatible" in the sense that they cannot be combined, but rather substitute each other with a resultant modification of hue in the dye, it is none the less true that the possibilities are infinite of varying the combinations among those that can be used to produce a dye. Of course, not all of these will be good; in fact, a minute proportion only will meet the rigid requirements for a commercial dye, because it is true that a dyestuff is much more than a dye—a fact which even the dye chemist is apt to overlook unless he becomes familiar with the past and present of the technology of dyeing.

Let us see how all this works out in practice. Let us suppose that the sales department wishes to be in a position to market

a certain colour which we shall call "Beetle Green 2BN." The desire of the sales department is due to their knowing that the commercial article is a direct dye of very excellent properties which make it a very important colour in its class. Prior to the war it was imported in very large quantities and sold by Cartel & Company, of Bingen, on the Rhine.

It is then the duty of the research department to acquire the information necessary to enable the operating department to make the dye. This does not mean, as the average research chemist is apt to think, that the chemistry of the process and the constitution of the dye must be made known before anything can be done. It is only necessary to know the materials used, their proportion, and the conditions for their interaction. On the other hand, it is true that if the constitution can be determined, the method of production can usually be worked out.

The choice then lies between a recipe or an exact knowledge of the structure of the dye. Having in certain respects a very exalted notion of the powers of the chemist the public assumes that he can analyse anything. The analysis of a dye is a very difficult undertaking, one more likely to result in wasted effort than in the identification of the composition of the material. The problem is nearly as difficult as that of determining the constitution of one of the simpler alkaloids, and that is admittedly a task which may occupy a research chemist a number of months, or, more usually, years.

In the case of dyes, the real difficulty is that the disintegration of the molecule gives rise to a mixture of components whose members are usually extremely sensitive to oxidising agents. Furthermore, the systematic analysis of dyes, as contrasted with their identification, has not progressed very far except, perhaps, in the laboratories of the German dye manufacturers.

Also it should be mentioned that an analysis presupposes a sample of fairly generous proportions, while it may well be that five grams is the total available for the research and the necessary dye tests which must be made in order to confirm the research results. Frequently the matter is quite hopeless, because no sample is available.

If the analysis is so unproductive, then recipes must be found and the best collection of these which is available to the American chemist is that contained in patents. Occasionally the research literature may be consulted with success, but, generally speaking, the patents are the only source of information.

Two Difficulties

However, there are two very grave difficulties which are quite obvious on even a superficial investigation of the problem, and many more which become apparent on closer scrutiny. The most evident is that the patent describes the dye either as the result of a process or as a compound of a certain structure; it says nothing about the name under which it is marketed. The next is that the patent may cover fifty or more examples, a quarter of which may be described as possessing properties somewhat like that of the dye in which we are interested.

Let us return to our hypothetical "Beetle Green 2BN." This dye was put on the market in 1903; that makes it probable that the patent covering it appeared about that time. Supposing that we have great luck, that the case is an impossibly easy one, then we shall find a patent assigned to Cartel & Company, and describing green to blue dyes of approximately the properties of "Beetle Green 2BN." However, patent claims are very indefinite, and there may be merely a statement that the dyes described dye cotton directly in green to blue shades and that they are metallic powders.

Now the patent covers all that it can. It may, for instance, claim a diphenyldiamine or its derivatives, coupled with a phenol, cresol, or the like, coupled with a 1·8-amino naphthol sulfonic acid, coupled with a substituted aniline. There is nothing to do but to set the laboratory to work on an investigation of the claims of the patent, in which the skill of the chemist and his knowledge of dye constitution will determine the success of his work. It will be at least several weeks before certainty can be reached. Evidently the investigation of a number of patents and their relation to commercial colours will take time, money and a really good research organisation employing many chemists.

But we have been assuming a very simple case. Suppose that you find that Cartel & Company took out six or more patents covering green to blue dyes—the complexity becomes just that much more difficult to unravel. Supposing that you find no patent that applies, then you are free to choose from a number of suppositions; the dye may not have been patented because the discoverer could not obtain a patent; the dye was discovered and patented by the chemists of another firm; the dye is covered by a much earlier patent which was not previously used because of some difficulty which was overcome only some years later; the dye is a mixture (this is quite possible and cannot be decided without a sample); the dye is not described as a green in the patent, but as a blue of a greenish shade.

You will appreciate what a problem such a case may present and how every shred of information must be utilised. This does not argue a faulty knowledge on the part of our chemists—the German chemists have often found it impossible to identify a colour put out by a competitor. The truth is that it takes nearly as much effort to decipher the correlation between patent and commercial dye as it does to discover the colour originally, and this has been the chief cause of the delay in making the newer dyes.

The matter would not have been entirely different had the patent laws required a greater precision in defining the claims of a patent or in limiting the field covered, although such a requirement might have helped in some instance; it would have been easy to take out ten patents instead of one except for the added expense, and it would have been nearly as hard to decide between ten patents as it is to decide between ten examples in one patent.

Moreover, we should remember that to require greater precision weakens the protection offered, because it makes patentable by others, modifications which would have been covered by the basic patent under the existing system. Whether this is desirable or not, I do not pretend to say, only if we amend the law to force foreign firms to disclose more, the new requirements will apply to ourselves equally.

In conclusion, I wish to state that patents have been extremely valuable to us because the protection afforded to them forced the German firms to publish at least something. Without the patents, the prospect for the newer colours would be much worse than it is. I believe that we can find our way through the maze; there are methods by which the problem can be solved. Just what these are, I prefer to leave unsaid, because by doing so I may persuade others to find still better methods than those I have worked out. One thing I am sure of is that those who have the necessary information can hardly do a greater service to the dye industry of this country than to engage in the very fascinating task of which I have given you this very brief sketch.—*The Journal of Industrial and Engineering Chemistry.*

Hardstoft Oil Yield

In connection with Mr. Bridgeman's statement in the House of Commons last week that the well at Hardstoft continues to flow at the same rate, and the crude oil is at present being held in storage, it is pointed out that when oil was first discovered at Hardstoft as the result of experimental drilling it was allowed to flow naturally. Later, steps were taken with a view to pumping, but, there being difficulties in getting machinery, it was decided to test the productivity of the well by baling with double shifts, which would keep down the level of the oil. Experiments on these lines were carried out for several weeks, and it was found that the well had a net producing capacity of over 35 barrels a day. The capacity of a barrel is about 35 gallons. In the present circumstances, while the oil has to be stored pending the decision as to its ownership, it was felt that there was no advantage in continuing baling, and since then the well has been allowed to yield its natural flow of between 9 and 10 barrels a day. It is not generally realised in this country that the average yield of the wells in the United States is below this figure. According to the United States Geological Survey, the daily production per well in 1915, 1916 and 1917 amounted to 4½ barrels. This figure includes wells which have been flowing and pumping for many years, but, even if the production of new wells is taken, the average is lower than would be anticipated. In Pennsylvania, where the high-grade oil somewhat resembles that at Hardstoft, the average daily initial production in 1917 was under 15 barrels. In Oklahoma the average production from new wells was much higher—80 barrels per day.

The Society of Chemical Industry

Meeting of the London Section

At the meeting of the London Section of the Society of Chemical Industry on Monday, Mr. Julian Baker in the Chair, Dr. Charles A. Keane and Dr. Stephen Miall were presented with silver bowls.

The Chairman in making the presentation referred to the magnificent success which Dr. Keane as chairman of the London Section, and Dr. Miall, as hon. secretary, made of the annual meeting of the Society in London last year. Both Dr. Keane and Dr. Miall expressed their appreciation of the gifts, the former mentioning that as the result of the conferences that took place with some of our Allies, important developments had followed. He emphasised the need for all members of the Society to work together and mentioned the financial difficulties with which the Society is now faced, difficulties which were hampering progress. With unity, however, these difficulties would be overcome and the chemical industry would make a bigger name than ever for itself.

The deaths of Dr. Messel, a past president of the Society, foreign secretary and a past chairman of the London Section, Professor Huntington, and Professor Watson Smith, Editor of the Journal until four or five years ago, were reported.

Theory of Gas Scrubbing Towers with Internal Packing

There were three Papers down for reading, the first being on "The Theory of Gas Scrubbing Towers with Internal Packing," by Professor F. G. Donnan, F.R.S., and Mr. J. I. Orme Masson.

The Paper was entirely theoretical and mathematical. The authors considered the removal of a soluble constituent from a mixture of gases and obtained general equations showing how the operation efficiency of a tower depended on the nature of the dissolved gas, the solvent fluid, the rates of flow of gas and liquid, the character of the packing and the height and section of the tower. Experimental results had not yet been obtained to verify the theory.

Dr. R. Lessing, who opened the discussion, said he would speak on the practical and not the theoretical side. An important question was viscosity, and means must be found for finding an expression for it. He referred to scrubbing with oil as against scrubbing with water or aqueous liquids. Scrubbing with oil came into prominence during the war for toluol recovery from coal gas and coke oven gas, and viscosity was of very great importance particularly as regards subdivision and turbulence. In order to reduce the total volume of a tower to the minimum it was necessary to use packing bodies of small cubic capacity and he exhibited some specimens of Raschig rings which, he said, occupied an exceedingly small proportion of the total volume of the tower. Whereas in the case of a solid packing 74 per cent. of the total capacity of the tower would be taken up by the solid material, with rings of the type he had mentioned and of 1 inch size, the volume percentage occupied was of the order of 7-9 per cent. if the rings were made of metal or 16-20 per cent. if made of clay or acid resisting material. This had an important bearing on viscosity and in order to improve the position still more he had designed a ring of the same cylindrical shape but with a centre partition which did not reach to the other side of the circumference. This had the advantage of improving the efficiency both as regards the total surface and also drainage, which was an important practical point. Poor drainage set up back pressure, whereas the great thing in designing a scrubbing tower was to do so with the least back pressure. Concerning turbulence he suggested there might be a critical point at which it became excessive, and he would like to know whether the authors had considered that point. In considering solubility, he suggested that one other phenomenon might be brought within the sphere of calculation, viz. fractionation. It might or might not be a simpler problem than that of a solution where they had to deal with a binary system of two similar substances like benzene and toluene, which was condensed and the condensate dissolved in the other condensate and vice versa. He also showed some quarter-inch rings which were being used for experimental purposes with which he had obtained fractionations better than any he had known before. If such rings could be used on a commercial scale they would improve the efficiency of the towers considerably owing to their very much larger surface per cubic foot compared with one-inch rings.

Professor Partington who, together with Dr. Parker, recently published a Paper on the same subject, said that although the authors of the present Paper had attempted to take note of the change of concentration as well as of the differential rate of flow, he had found that in practice in nitric acid towers there was very little change of concentration of the liquid in passing through the tower. The rate of circulation was so high that the liquid had much the same composition throughout the tower. He regarded the absorption coefficient as the most important in the authors' equations, *i.e.*, the number of pounds of soluble matter of the gas absorbed in a given time by a given surface of liquid. An attempt had been made to bring it into line with the Henry coefficient, but in practice this latter did not apply to very many cases, and in his work he had decided to drop it and to lump together into one coefficient all the variables, although he agreed it would be better if all the variables could be dealt with separately. In the Paper by Dr. Parker and himself they had pointed out that the absorption coefficient depended upon a number of things, on turbulence, on the concentration of the gas and the liquid and a number of things, and their own case was still further complicated by the fact that chemical reactions took place in the liquid and the gas. However, it was found that the equations they arrived at agreed very well with practice in certain cases. The aim they had in view was to get a practical formula by means of which the engineer could work out results by simple formula and they believed they had got some way towards it.

Captain Goodwin said the modern tendency was not to have a steady rate of flow down the tower as the authors had assumed, but to have a periodical flushing down the tower and a coefficient was required which assumed that the liquid on the packing was renewed or nearly renewed at each flushing. An important point was the direction of the gas flow which, in every text-book and Paper on the subject, was always caused to travel up the tower. It seemed to be assumed as an incontrovertible fact that the system of contra-flow must be more efficient than parallel flow. In some cases, however, that was not so. With a parallel flow of liquid and gas the time contact was increased and an improved efficiency was often obtained by using parallel flow. It was also very important to take into account the question of free space mentioned by Dr. Lessing in conjunction with the surface of the packing per unit volume.

Mr. Macnab mentioned that during the war it was found that using Accrington rings, which were large, many factories worked with about 50 per cent. free space, and uniform results were obtained when using 1 lb. of nitrogen peroxide per 120 feet.

Mr. Griffiths, commenting on the assumption in the Paper that the temperature was constant, said that from his experience with condensing towers this condition did not always apply.

Dr. Parker speaking with regard to the question of free space said that many absorption systems which ought to have an efficiency of 90 per cent. only had an efficiency of 70 per cent., because a far larger proportion of the area was occupied by packing than was necessary. The efficiency could in many cases be considerably improved by re-packing.

Mr. P. Parrish said the Paper was too involved for him to attempt a detailed criticism at the moment, but the practical chemical engineer would welcome very much the data afforded in it. His own experience had been in the design of towers for sulphuric acid manufacture, and it was not always realised that the design of a Glover tower was dependent, not only on the proportion of the chamber plant and burners in relation to it, but on the capacity and effectiveness of the Gay-Lussac tower, which had a very important bearing on the Glover tower. The general data upon which Glover towers had been designed for the past 15 years had been that 550 cubic feet of Glover tower capacity was required for every ton of pyrites, but that paid no regard to mass, to available surface area or the effective scrubbing surface per cubic foot. Consequently a short time ago he made an attempt to correlate the theoretical and practical data which he had accumulated as the result of the design of a large number of sulphuric acid towers and communicated it to one of the technical journals. He proceeded to elaborate the design of Glover towers in so far as

they affected the manufacture of sulphuric acid, and had come to the definite conclusion that it was absolutely necessary to afford 4¼ sq. ft. of surface area at a point in the tower where the lining of the tower was not more than 15 in. His investigations convinced him that in regard to packing there were many cases in which Glover towers were over designed to the extent of 300 and in a few cases 500 or 600 per cent., compared with what was theoretically necessary. The future tendency in the design of Glover towers would be, as regards absorption, on the lines of the Kestner plant. There were, however, quite a number of other considerations in the design of Glover towers than that of absorption, and it was failure to take these into account which resulted in the over designing to which he had referred, and from that point of view the equations in the Paper would be extremely valuable.

Dr. W. R. Ormandy said that he had recently designed an absorption tower on the lines of the engineer in designing a bridge, viz., he assumed a good factor of safety and then doubled it, to make sure. He had to do this because there were no data available. The results of the working of that plant, he thought, would give the facts which Professor Donnan required in order to interpret his theory.

Mr. J. I. Orme Masson briefly replied to the discussion.

Yorkshire Section

AT the annual meeting of the Yorkshire Section, held at the Queen's Hotel, Leeds, on Monday, May 3, Mr. S. M. Davies (York) was elected chairman for the ensuing year, Mr. L. L. Lloyd (Bradford) vice-chairman, and Messrs. J. I. Graham (Doncaster), L. Leaverson (Huddersfield) and A. B. Searle (Sheffield) were elected to vacancies on the committee.

Papers

Following the business meeting, two Papers were read. Mr. G. B. Howarth, of the Coal-gas and Fuel Industries Department of the Leeds University, whose subject was "Graphical Methods for Interpreting Flue Gas Analyses," referred to the complexity of the flue gas calculations usually involved in efficiency tests of boilers and other heating appliances, and after reviewing the shortcomings of a well-known graphical system of German origin, described the steps by which he had developed a series of diagrams to give rapidly, from a simplified flue gas analysis, accurate indications of the amount of surplus air admitted to the furnace and of the heat lost up the chimney with the flue gases.

Mr. G. F. Pickering, in a Paper on "Commercial Analysis of Sulphonated Oils," described the methods of analysing sulphonated oils given in recognised text books as seriously defective. Many of these older methods were claimed to be satisfactory for scientific analysis; but in practice they had been found inefficient, even for commercial work. As manager and head chemist of an oil and stearine works, he had had to work out new methods. These he explained in detail, but added that much further research would be required before the methods were really satisfactory.

Shipping for Chilian Nitrate

Arrangements have been made by the Shipping Board whereby sufficient tonnage will be furnished for the importation of Chilian nitrate needed as fertilizer for next season's crops. Approximately 270,000 tons will be brought to the United States before July 1, and some of the shipments have already started.

Mr. H. Morpey, manager of the by-product coking plant in connection with the Mitchell Main Colliery, Wombwell, Worcester, sends us a pamphlet describing a method of determining contents, from dip, of partially filled cylindrical tanks lying horizontally, which he claims is quick, convenient and reliable. The pamphlet contains a table giving the areas of 1,000 segments of the circle expressed as percentages of the area of the circle, and the size of the table is such as to give a percentage reading for each $\frac{1}{10}$" dip in a vessel 8'-4" diameter, and, of course, for lesser diameters, proportionately closer readings. This means that, in all practical cases, the readings of the table are closer than the possible accuracy of dip. The results embodied in the pamphlet are based on 25 years' experience in the chemical trade, and the author's sense of the need of some quick and accurate method of determining the contents of partially filled horizontal cylinders.

Scientific Esperanto

THE question of the adoption of Esperanto as the vehicle of international scientific discussion was treated in a Paper read by Mr. L. Nobes at a meeting of the Chemical Society of the Royal College of Science on April 30. Though somewhat apart from the usual programme of a chemical society, the subject with its special bearing on the routine of chemical research aroused very keen interest, which was evidenced by the animated discussion following the reading of the Paper.

In his opening remarks the lecturer defined Esperanto as an international auxiliary language, in no sense designed to replace any existing language. After relating the story of the growth of Esperanto after its publication in 1887 by Dr. Zamenhof, a Polish medical man, the lecturer proceeded to the main theme of his Paper, an exposition of the scientific structure of the language and of the ways in which it might be applied to the needs of science.

In order to demonstrate the simplicity and regularity of construction in Esperanto and the conciseness and perspicuity of diction thus gained, a full analysis of the use of the verb in Esperanto was given. The method of vowel change, by means of which the simple tenses (present, past and future) are capable of expression by three forms only, was shown to produce a remarkable degree of flexibility and conciseness and an abnormal capacity for fine distinction, when applied to the auxiliary verb and the participle of compound tenses. As examples of this, a few of the forms given may be quoted :—

I shall be about to filter	Mi estos filtronta
They will have been examined	Ili estos ekzaminitaj
The person (or thing) being examined.	Ekzaminato
The person who had been examined..	Ekzaminito

Special attention was then drawn to the fact that, by an extensive and systematic use of prefixes and suffixes, it had been found possible to construct a vocabulary on the basis of a comparatively small number of root-words borrowed from existing languages: a vocabulary that is not merely adequate but which provides in an unrivalled degree for the expression of shades of meaning.

Progress on the Continent

Though little had been done in England with regard to the development of the language in the interests of science, on the Continent the Scientific and Technical Commission of the International Scientific Association, on which many famous scientists had served, had drawn up in 1911 a representation on the subject of the plan to be adopted for the formation of scientific and technical words not previously existing in Esperanto.

As regards the advantages which would accrue from the employment of an international language, the possibility of the establishment of an International Congress for the ventilation of scientific matters was suggested as indicating one important application; and, secondly, the publication of scientific reports in Esperanto, at first in the form of appended abstracts and subsequently in their entirety.

At the close of the lecture Dr. H. Harwood, Ph.D., referring particularly to the last point made by the lecturer, quoted two instances of contributions to chemical knowledge which, though of outstanding importance, had remained for many years unknown to the general scientific world by reason of their original publication in little-known languages—that of Cannizarro on Avogadro's Hypothesis and the more recent researches of Von Fédérof on crystal analysis. Referring then to the adoption of French by the Postal Union for official communications, Dr. Harwood suggested that this might foreshadow the general adoption of French as the international language.

Discussion

In the course of the discussion which followed, several interesting points were raised. On the one hand, it was suggested that Esperanto might be made a compulsory subject in the examinations for university degrees in substitution for the French and German at present required; and, on the other hand, it was objected that, with the great bulk of technical literature already existing in German, it would be inexpedient to attempt the colossal task of reproducing this in Esperanto. The Secretary of the British Esperanto Association testified to the practical utility of Esperanto, proved conclusively by the numerous international meetings at which he had taken part.

Death of Professor Watson Smith

WE regret to record the death, which took place on Saturday last at Hampstead, after a short illness, of Professor Watson Smith, F.I.C., F.C.S., in his 75th year. Professor Smith, who was a native of Stroud, was educated at the Owens College, Manchester, Heidelberg University, and the Polytechnikum, Zurich. He was widely known and highly esteemed for his work in connection with the Society of Chemical Industry in which he took a keen and devoted interest. He served as editor of the Society's *Journal* from 1881 to 1915, and was on the first staff of abstractors for the *Journal*. He had had a wide experience both in chemical science and industry. In addition to serving as chemist and manager in works and factories for ten years, he held appointments as examiner to the Institute of Chemistry, Lecturer in Technical Chemistry at the Owens College, and Professor of Applied Chemistry in University College, London. He had done a considerable amount of original research, and was the discoverer of the true causes of flour-mill explosions, of dinaphthyls and phenylnaphthalene, and of arseniate of eucalyptol and glycerol phthalate. He also carried out investigations into Miike coal and its high resinoid constituents. His publications mainly consisted of contributions to the *Journal* of the Society of Chemical Industry on the destructive distillation of wood, resinoid coals, ammonium salts, by-products of coke ovens, blast furnace gases and tars, &c. Outside his professional work, he found recreation in musical composition. The funeral took place at Hampstead yesterday (Friday).

Sequel to Soap Contracts Action

IN the King's Bench Division on Monday, Mr. Justice Lush heard an action brought by Reginald Godfrey & Co., Cannon Street, E.C., against the Aniline Dye Co., Ltd., and J. J. Gibson, Lucy Street, Hulme, Manchester, claiming £500 arising under a compromise in another action concerning contracts for soap.

For the plaintiffs, Mr. H. Morris said that the defendants were the Aniline Dye Co., J. Gibson, Ltd., and James Gibson. The parties had traded together. In the latter part of last year the Aniline Dye Co. sued the present plaintiffs and Reginald Godfrey & Co. counter-claimed and also put forward a claim against James Gibson. Reginald Godfrey & Co. were also sued for £715 on a bill of exchange. Their defence was that the goods in respect of which the bill was given had never been delivered. The case came before Mr. Justice Darling, and while he (counsel) was opening, he was informed that a settlement had been arranged. It was upon these terms of settlement that the action for £500 was now brought. The terms of settlement were that the action should be dropped, no order as to costs, and the bill of exchange delivered up, the Aniline Dye Co. and J. Gibson & Co. to pay Reginald Godfrey & Co. £500 in a week. A term of the settlement was that Mr. J. Gibson should be personally liable for the £500. Counsel added that the £500 was not paid and the present writ was therefore issued. The defence set up was that a mistake of fact had been made in coming to the settlement, the mistake being that Mr. Gibson understood Messrs. Godfrey were dropping the defence to the bill for £715, and this amount would be paid by them to Gibson's, who would pay Messrs. Godfrey £500.

Mr. James Gibson, the defendant, gave evidence that when he agreed to the settlement he understood he was only compromising the counter-claim. He did not understand he was giving up the claim for £715 on the bill of exchange.

His lordship said there was no defence to the action. When Mr. Gibson signed the settlement he knew perfectly well that the action on the bill of exchange was to be dropped. There would be judgment against Mr. Gibson personally and against the two companies for the amount claimed.

Books Received

HANDBOOK TO THE LIVERPOOL COMMERCIAL REFERENCE LIBRARY. Compiled under the direction of the Chief Librarian. Liverpool Libraries, Museums and Arts Committee Reference Library, William Brown Street. Pp. 42.

SOUTH WALES COALS, THEIR ANALYSIS, CHEMISTRY AND GEOLOGY. By Llewellyn J. Davies, F.C.S. The Business Statistics Company, Ltd. Cardiff: Pp. 101. 10s. 6d.

Oxide Purification

"OXIDE PURIFICATION" was dealt with by Mr. Geofrey Weyman in a Paper before the North of England Gas Managers' Association at their annual meeting on Saturday, May 1, at Newcastle-on-Tyne.

Mr. Weyman began by remarking that the subject deserved a great deal more attention than it had hitherto received. Unlike many catalytic reactions they could isolate the intermediate compounds—the sulphides—and thus follow to a great extent the part played by the iron in the reaction. He considered it an advantage to accelerate the reaction as far as possible and limit the formation of the sulphides to a short period, as by doing so they could avoid the necessity of removing the purifying material to the open air to oxidise.

Mr. Weyman gave in detail the results of many fouling tests he had carried out and remarked that it was noticeable that on drying some of the varieties fell very far short of the maximum activity. No preparations he had made had given the maximum activity when dried at 100°C., and most gave the full activity when dehydrated at a temperature of about 600°C. At that stage the behaviour of the oxide was erratic. It might remain exposed to the action of the hydrogen sulphide for some time before absorption set in, and then the combination was sudden and complete. That curious behaviour was sometimes noticeable when using burnt oxide in practice. Above 700°C. the time of exposure to hydrogen sulphide had to be lengthened before anything happened, becoming longer and longer until, for all practical purposes, the oxide was inactive. Duration of heating as well as temperature affected the result. He classified the oxide of iron in common use as (1) True bog ores, best Dutch and Irish; (2) degraded iron ores; (3) burnt pyrites and burnt spent oxide. The true bog ore could be taken as essentially ferrous hydrate precipitated on peat fibre and was very effective and the most easily worked material; the second group could never carry such a large amount of water as bog ore without loss of efficiency; the use of the third series usually meant working at a higher temperature than would be necessary with a bog ore.

In the latter part of his Paper Mr. Weyman raised the question whether it were possible to convert a relatively large quantity or all of the sulphur into sulphate and the remainder as free sulphur. It would obviously be a great advantage to do so as the sulphate of iron so formed even if not sold as such could be converted into sulphate of ammonia and residue of iron oxides suitable for further purification. While work was proceeding on those lines it could be safely stated that with a certain quality of ferric oxide and at higher temperatures than those usually used, and in the presence of steam such a process was quite feasible.

The sample of ferrous sulphate which he exhibited to the members was made directly in the way indicated and was taken from a batch of about 40 tons which consisted very largely of ferrous sulphate. The process could be very conveniently introduced where an oxide box followed a sulphate of ammonia plant for purifying waste gases. There the conditions of temperature and admission of steam were easily controlled. Whether it could be applied to coal gas purification remained to be seen, though it certainly did take place to a certain extent in ordinary practice. At all events he thought that the possibilities of oxide purification had not been exhausted by a long way.

SANITAS CO.—A final dividend has been declared of 4½ per cent., making 9 per cent., on cumulative preference shares, payable June 1.

OXFORD University has received an offer from Mr. Edward Whitley of £10,000 towards the endowment of a professorship of biochemistry, and a donation of £5,000 from the British Dyestuffs Corporation, Limited, towards the cost of extending the organic chemical laboratory. It is estimated that the completion of the organic chemical laboratory, with fittings, will cost £45,000, and the Curators of the University chest have been authorised to accept contributions in addition to the gift of £5,000 from the British Dyestuffs Corporation. A further donation of £1,000 has been received from Explosives Trades, Limited.

Chemical Matters in Parliament

Machinery for Kelham Factory.

Sir A. Boscawen, in reply to questions regarding the placing of the order for machinery for the Kelham Sugar Beet Factory with a French firm instead of with an English one, stated that invitations to tender for the supply of the machinery were specifically invited from British engineering firms by advertisements, but the response was disappointing. The company also took expert advice as to foreign firms who had experience of beet sugar machinery, and on such advice invited the Compagnie de Fives, Lille, to tender, and after considering all the circumstances decided to give the contract to that firm. It had, however, been arranged that British firms who specialised in specific parts of the machinery should have the opportunity of acting as sub-contractors for such parts. It was the view of the Ministry that if success was to be attained the directors of Home Grown Sugar, Ltd., must be allowed to manage the business of the company as they thought best, subject only to such control by the Government's financial representative as was necessary to safeguard the State funds which are invested in the enterprise.

Shell Transport and Trading

Mr. Baldwin, in reply to Mr. Shortt (House of Commons, May 3), stated that the Government was not negotiating with a view to the purchase or of securing greater control of the Shell Transport and Trading Co.

Psychological *v.* "Scientific" Management

At the spring meeting of the Refractory Materials Section of the Ceramic Society, held at Stoke on Trent, a Paper was read by Dr. C. S. Myers entitled "Psychological *versus* Scientific Management," in which it was pointed out that of recent years, although efforts had been made to introduce from the United States into this country a system of industrial organisation known as "Scientific" management, these efforts had not been successful, for the reason that the British workman had shown himself generally as distinctly opposed to so-called scientific management. The cause of this attitude was not difficult to find. It had arisen partly because a system which had met with some temporary success in one country had been introduced, without notification, into another where the conditions of labour were obviously different. A still more fundamental cause of the failure was, however, that scientific management, as originally advocated, could not be expected to be generally or permanently successful in any civilised land. At a meeting of electrical engineers, recently held in London, one speaker after another adversely criticised the system on the ground that it did not take sufficiently into account the human aspect of the problem.

Whereas scientific management aimed at turning the worker into an obedient machine, psychological management regarded him as a human being, and hoped to invest him with as much knowledge of, and voice in, his industrial surroundings as were compatible with the most efficient management. A National Institute of Psychology and Physiology applied to industry was now being established in our country. Its chief objects would be to provide training in the provision and application of tests by which applicants for work could be appointed to occupations for which they were physically and mentally best fitted; to study and determine the conditions which tended to the mental and bodily health of the workers, and to harmony and co-operation between management and labour. Scientific management must be supervised and controlled by psychological management.

A New Rubber Process

The *Scientific American* reports that an English chemist has demonstrated on a laboratory scale a process which may revolutionise the methods of rubber manufacture, if it proves as successful on a commercial scale. At present the latex must be converted into rubber within 24 hours from the time it is extracted from the tree, to prevent putrefaction, but when treated by the new process it is said that it can be kept for any time. It now takes at least a fortnight to bring raw rubber into condition for transmission to the market, but the new process reduces this time to 30 minutes.

Government Chemists' Salaries

British and American Scales Compared

The issue of *Chemical and Metallurgical Engineering* for April 14 summarises the report of the American Congressional Commission on re-classification of salaries, &c., of Government-Employed Chemists.

In the following table a comparison of the salaries recommended by this Commission with the salaries now paid to chemists in the Department of the Government Chemist, is made by converting dollars approximately into sterling, taking exchange at par and at the present rate of 3·86 respectively. The middle figures in each column represent the amount of periodical increment from the lower to the higher figure :—

American Service.

	$	Equivalent to £ sterling with exchange at	
		par (4·86),	(3.86).
Junior Chemist.....	1,800-120-2,160	370-23-445	465-31-560
Assistant Chemist...	2,400-120-3,000	495-23-630	620-31-775
Associate Chemist...	3,240-120-3,840	665-23-790	840-31-990
Chemist	4,140-180-5,040	850-37-1,035	1,070-47-1,300
Senior Chemist	Not specified.		

British Service.

Temporary Chemist's Assistant	£268-13-346
Second Class Analyst	352-26-580
First Class Analyst.....	645-26-905
Superintending Analyst.....	970-32-1,165

The comparison is not absolute, since the respective duties of the grades in America and in England are a little different, but the figures are certainly of interest, and it is to be remembered that the salaries paid to Government chemists in this country are inclusive of a war bonus, which may or may not be added permanently to salary.

The Commission state that the commencing salary for junior chemists in Government service is slightly higher than that which such chemists are able to command in industry (usually $1,500, *i.e.*, at present exchange about £390). They state, however, that chemists in industry are usually advanced much more rapidly than is possible in the Government service. Promotion in the American service, through a grade and from one grade to another is practically automatic from year to year, provided the services of the chemist are in every way satisfactory, but provision is made for holding up promotion in the event of unsatisfactory service not necessitating dismissal, or for double promotion in the event of particularly good service.

Nitrate Railways

Mr. A. H. A. Knox-Little (chairman), who presided at the thirty-eighth general meeting of the Nitrate Railways Co., Ltd., in London, on Tuesday, said that the prospects for the present year were much more favourable than they had been for the past year. The revival that had taken place in the nitrate industry was most marked, and with tariffs placed on a better basis, instead of the unreasonably low rates that had ruled during the last five years, the first three months of the year showed an increase in gross receipts of £135,704. This increase had the result of reducing the percentage of working expenses to gross receipts and consequently they had considerably better net receipts. According to the figures given to them by the nitrate producers, they expected a great increase in the carriage of nitrate. They were informed by the Chilean Nitrate Committee that their advices from Chile were to the effect that an export of 26,400,000 quintals per annum of nitrate from the port of Iquique must be anticipated in the near future. This represented an increase of about 50 per cent. over the quantity hitherto exported from this port in any single year, and meant the carriage of 1,200,000 tons a year, or 4,000 tons a day, taking 300 working days in the year.

An abstract of the accounts was given in our last issue.

Dyestuffs valued at over £80,000 were destroyed by a fire which almost completely destroyed the dyeing works of a large hosiery factory at Troyes on Sunday.

Sheffield's Glass Industry

WHEN the war broke out a scientific advisory committee was established at Sheffield University for the purposes of giving technical assistance to manufacturers in various branches of industry who were likely to find themselves in difficulties through the withdrawal of supplies of raw materials or manufactured articles, and of getting new industries started to provide essential things. Before long, a *Times* correspondent states, inquiries began to come in from glass manufacturers in the neighbourhood of Sheffield, and it was realised at the University, for the first time perhaps, that the glass industry of the West Riding of Yorkshire was of an important character, and that no university had attempted to offer a course of instruction to assist such an industry or to carry on research which might lead to its improvement. It was decided that glass technology should be taken up, not purely from the local, but from a national point of view. An appeal for support was made to manufacturers, and teaching began at the end of 1915. This at first was of an elementary character, and the classes were attended by persons actually engaged in the industry. The success of the experiment was immediate, and manufacturers who had held aloof from the movement soon expressed through their trade associations a desire to come in and help. With the financial assistance then afforded a new block of buildings was erected to form the nucleus of the department, and since the beginning of 1917 the work of instruction has grown rapidly. The University now offers a complete course leading both to a diploma and the degree of Bachelor of Technical Science, granted on much the same basis as degrees in engineering and metallurgy.

From the outset the research aspect was kept in the forefront, and, if anything, was emphasised more than the teaching work. A start was made in 1915 with two scientific workers, but as the work extended the staff was increased to 10, exclusive of secretarial and other assistants. Since the necessary equipment was obtained over 30 papers involving experimental research have been published, and others which have been read are being prepared for publication. Useful service has also been given to the glass branch of the Ministry of Munitions and to manufacturers, and in all 540 inquiries, some of them of a consultative kind, but many involving experimental work, have been dealt with. Research being of necessity slow in development, Dr. W. E. S. Turner, the enthusiastic head of the department, with the co-operation of manufacturers, brought into existence the Society of Glass Technology, which has now 570 members. The work of the Society has acquired such a reputation that it has nearly 100 members in the United States and quite a large number distributed through European countries and the Dominions. Under the editorship of Dr. Turner, a quarterly journal is published. One problem on which the Department of Glass Technology has concentrated is that of making good the deficiencies in the lamp-working branch of the British glass industry, a branch practically foreign to this country before the war. It is concerned with the production, by working and blowing glass tubing, of scientific, chemical and surgical glassware. In the past these articles came chiefly from Germany and Austria, although France sent us a limited quantity. At the present time disabled soldiers are being trained in the industry by the University. Other problems which have been tackled range from those associated with the commonest types of glass bottles to others concerned with glass for illuminating purposes and the making of artificial human eyes.

Recent Wills

Mr. E. W. Sheard, of Bristol, formerly in business as a dyer (net personalty, £10,608) £12,017

Mr. A. E. Hemingway, dyer, Batley £5,713

Mr. W. M. JOHNSEN, a director and founder of the Johnsen & Jörgensen Flint Glass, Ltd. (net personalty £112,866) £125,744

Tax-free Denatured Alcohol

The U.S. Department of Internal Revenue announces that by securing a permit, chemical and physical laboratories may use a special denatured alcohol tax free. This denatured alcohol is made up as follows: To each 100 gal. of 95 per cent. grain alcohol are added 10 gal. of pure wood alcohol of specific gravity of not more than 0·810 at 60°F.

Chemical Trade Inquiries

LOCALITY OF FIRM OR AGENT.	MATERIALS.	REF. NO
Canada (Nova Scotia)	Mica and Molybdenite	—
Egypt (Cairo) ...	Metals	605
Denmark (Copenhagen)	Glass. The form of tender (in Danish) may be consulted at the Enquiry Office of the Department of Overseas Trade.	—
Poland (Dantzig)	Portland Cement	612
Australia (Brisbane)	Glassware, earthenware	596
Canada (Montreal)	Hyposulphite of soda, naphthaline balls, Epsom salts, sulphide of soda, &c.	646
British Columbia	Talc, magnesite, magnesium, sulphate, carbonate, and sodium sulphate, &c. Replies to Canadian Government Trade Commissioner's Office, Portland House, 73, Basinghall Street, London, E.C.2.	—
Roumania (Bucharest)	Boric acid, carbolic acid, &c. Replies to Monsieur le Commandant I Cerna, Corpul Greniceri, Boulevard Bratiann (Colt cu Batiste), Bucharest.	—
Egypt (Alexandria)	Glassware, caustic soda, &c. ...	660
Mexico (Guadalajara)	Photographic chemicals	677

The British Chemical Trade Association

A FIRM in the United Kingdom desires to get into touch with firms who are in a position to offer supplies of lead arsenate. Members interested should communicate with the Secretary of this Association, 80, Fenchurch Street, E.C. 3.

Members are requested to forward any information from their records of sales or quotations as to the fair market price of Acetanilid U.S.P. Powder c.i.f. Rotterdam, during the month of March and the first two weeks in April, 1920. Any information furnished will be treated as confidential, and members' names will not be disclosed without their consent being previously obtained. The above information is urgently required.

Anglo-Continental Guano

THE third general meeting of the Anglo-Continental Guano Works, Ltd., was held in London on Wednesday. Mr. A. Mitchelson, who presided, stated that the difficulties besetting the trade since they met a year ago had not diminished; on the contrary, they had never experienced such harassing conditions, and therefore it was with special satisfaction that the directors now presented a balance-sheet showing an increase in profit of £16,723. Last year he announced the acquisition of three provincial concerns from which good results were expected. During the past year a fourth had been similarly acquired. The profits earned by these companies during the last financial year had warranted the transfer of a good dividend to the parent company and a carry forward in each of the four accounts of a sufficient amount to meet the costs of further modernising the several factories for increased and economical production. They had also purchased an old-established private business for the treatment of bones and other animal products essential in the manufacture of their fertilisers. They were bringing the plant and methods of manufacture up-to-date, and hoped in the future to realise appreciable advantages from this branch of the business. The profit for the year amounted to £60,579. The sum of £15,000 had been paid in dividend on the Preference shares, and £12,500 in an interim dividend at the rate of 12½ per cent. per annum on the ordinary shares, and the directors had declared a final dividend at the same rate on the Ordinary shares. They also proposed to allocate £4,833 to depreciation reserve, leaving £17,766 to be carried forward subject to excess profits duty for 1919.

The report was unanimously adopted.

From Week to Week

The GERMAN POTASH SYNDICATE last year produced 946,000 short tons, of which 264,000 tons were sold abroad.

The death took place on Thursday, April 29, at Dennistoun, of Mr. GORDON M'LELLAN, manufacturing chemist of Calton.

MR. MAX MUSPRATT, chairman of the United Alkali Co., left London last week to visit the company's properties in Spain.

The death is reported from Canada of PROFESSOR E. MACKAY, an active member of the Society of Chemical Industry and of the Canadian Institute of Chemistry.

The PETROLEUM BORING which has been in progress for some time at West Calder, West Lothian, has now resulted in traces of oil being found at a depth of 3,500 ft.

SIR HENRY BIRCHENOUGH has been appointed chairman of British Dyestuffs Corporation, Ltd., in place of Lord Moulton, who has resigned on account of pressure of judicial work.

The Governors of the SIR JOHN CASS TECHNICAL INSTITUTE invite applications for the post of lecturer in metallurgy, at a commencing salary of £315 per annum, rising to £440 per annum.

At a meeting of the Council of the British Empire Producers' Organisation last week the establishment of an EMPIRE LIQUID FUEL Section was discussed, and steps have already been taken towards its formation.

The Council of the BRITISH COTTON INDUSTRY RESEARCH ASSOCIATION invite applications for the position of head of the Colloid Chemistry and Physics Department, and of the Organic Chemistry Department, the minimum salary in each case being £1,000 a year.

Owing to illness, DR. WALTER ROSENHAIN, F.R.S., Superintendent of the Department of Metallurgy and Metallurgical Chemistry, National Physical Laboratory, was unable to deliver the third lecture of his course at the Royal Society of Arts on "Aluminium and its Alloys," last week

"Dibenzoparadiazine," in a letter to the *Daily Chronicle* on the SALARIES OF INDUSTRIAL CHEMISTS, states that some important Government laboratories which annually pass many thousands of pounds' worth of material into the Service, chemists are receiving actually 10s. to 15s. a week less than the labourers who sweep up the floors and clean the benches.

A verdict of "accidental death" was returned at the inquest at Newington last week regarding the death of Gerald M. Brown (18), a works chemist, of Nunhead, who died from the effects of bromine liquid gas fumes which he accidentally inhaled through dropping a bottle of liquid gas while carrying out research work.

A NEW LIQUID FUEL called Colloil has been developed and patented by Mr. G. C. Calvert, of the Metropolitan Laboratories, Elmhurst, Twickenham Park. Colloil is briefly a mixture of a fuel oil with coal or coke dust so treated that it has been brought to a partially colloidal state. The percentage of dust and oil are, it is stated, about 1 to 1, and it can be treated and incorporated with the oil at about 15s. a ton.

The project to utilise Messrs. KYNOCH'S large ammunition and explosive works at Arklow for the manufacture of artificial manure in conjunction with the development of the Avoca Copper Mines has, we understand, been completed. A company having a capital of £3,000,000 is to be formed, in which the Irish Farmers' Association and the mining company are to have large interests. It is also proposed to connect the Arklow works with the Dublin and South-Eastern Railway system by a new line of railway.

The death is announced of PROFESSOR W. PFEFFER, in his 75th year. Professor W. Pfeffer was a plant physiologist whose pioneer work on the measurement of osmotic pressure with semi-permeable membranes and its influence on the theory of solutions are well known to chemists. As a biologist his work was distinguished by reliance upon exact quantitative methods of inquiry. Professor Pfeffer was in turn ordinary professor at the Universities of Basle for 1½ years, Tübingen for 9 years, and Leipzig for 33 years.

At the annual meeting of the Chemical Section of the MANCHESTER LITERARY and PHILOSOPHICAL SOCIETY on Friday, April 30, the following officers and members of Committee for the new session were elected:—Chairman, Mr. J. H. Lester; vice-chairman, Mr. R. H. Clayton; hon. secretary, Mr. David Cardwell; other members of Committee, Dr. E. Ardern, Mr. F. W. Atack, Dr. W. H. Bentley, Professor Arthur Lapworth, Mr. Harold Moore, Professor F. L. Pyman, Miss R. Robinson, Mr. L. E. Vlies, and Mr. T. R. Wollaston.

A MESSAGE from Melbourne states that the Commonwealth House of Representatives on Tuesday adopted the first reading of the Bill approving the agreement between the Government and the Anglo-Persian Oil Co., to supply oil fuel at Australian Ports. The company, under the agreement, will form a refining undertaking with a capital of £500,000 in £1 shares, the Commonwealth taking up £250,000 worth of the stock, and also undertaking to protect the company by fiscal measures against dumping and unfair competition.

THE death is announced of Mr. O. J. D. Thomas, late chief chemist to the E. B. Eddy Co., of Hull, Canada. Mr. Thomas went to Canada several years ago and after spending some time in metallurgical work, engaged with the Eddy Company in 1917. He was well known not only in Ottawa, but in many other parts of the Dominion, and was an active member of the Society of Chemical Industry in Ottawa, in which Branch he had been one of the members of the Executive Committee for the past two years.

The report which has been circulated to the effect that a concession of all PHOSPHATE RIGHTS IN MOROCCO is to be granted to an American or a British syndicate has been, we understand, officially denied. The Sherifian Government will retain this privilege. The value of the phosphate beds in the French Protectorate has been estimated at £3,600,000,000. It is anticipated that in three or four years they will be yielding a revenue of £1,200,000, which will be devoted to the improvement of local agriculture and to the upkeep of French troops in Morocco.

THE amalgamation is announced of R. GRAESSER, LTD., of Ruabon, N. Wales, and the British interests of the Monsanto Chemical Works, St. Louis, U.S.A., in a new company which has been formed under the style of THE GRAESSER-MONSANTO CHEMICAL WORKS, LTD. The new company will carry on the manufacture of the products hitherto produced by R. Graesser, Ltd., and will also undertake the manufacture of Monsanto products. Mr. N. H. Graesser, the managing director of R. Graesser, Ltd., will be the managing director of the new company. Mr. Robert Du Bois and Dr. Veillon, formerly of the Monsanto Chemical Works, are joining the board of directors of the new company.

The *Times* correspondent at Simla states that the Chemical Services Committee, presided over by Professor Jocelyn Thorpe, recommend the constitution of an INDIAN CHEMICAL SERVICE and the establishment of an Imperial Research Institute at Dehra Dun (United Provinces) and a provincial institute in each province, also the creation of a Ministry of Science as soon as possible. Professor Thorpe, reviewing his tour through India, states that very few of the great natural resources of the country were being exploited to advantage, and where here and there this is being done the processes employed are often crude and wasteful. If the resources of the country were developed to the fullest extent India would take its place in the front rank of industrial communities.

Sir Richard Glazebrook, F.R.S., has been appointed first president of the NEW INSTITUTE OF PHYSICS, which has been founded by the co-operation in the first instance of the Faraday Society, the Optical Society and the Physical Society of London. The treasurer is Sir Robert Hadfield, F.R.S., the hon. secretary Professor A. W. Porter, F.R.S. The other members of the Board are: Dr. H. S. Allen, Instructor Commander T. V. Baker, R.N., Professor F. J. Cheshire, Dr. R. S. Clay, Mr. W. R. Cooper, Professor W. H. Eccles, Major E. O. Henrici, Dr. C. H. Lees, F.R.S., Mr. C. C. Paterson, Major C. E. S. Phillips, Dr. E. H. Rayner, Mr. T. Smith and Mr. R. S. Whipple. Mr. F. S. Spiers has been appointed secretary to the institute, and further particulars and forms of application for membership may be obtained from him at 10, Essex Street, Strand, W.C. 2. It is hoped that in the course of time other societies will associate themselves with the institute. Members of the institute who are also members of more than one of the co-operating societies will obtain a reduction in the subscription to those societies.

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Miscellaneous

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Specific colour reaction of oxalates. V. Macri. *Boll Chim. Farm.*, February 29, 73.

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We publish each week a list of selected complete specifications accepted as and when they are actually printed and on sale. In addition, we give abstracts within a week of the specifications being obtainable. Readers can thus decide what specifications are of sufficient interest to warrant purchase, the only way of obtaining complete information. A list of International Convention specifications open to inspection before acceptance is added, and abstracts are given as soon as possible.

Abstracts of Complete Specifications

122,179. GAS, PROCESS OF AND MEANS FOR THE MANUFACTURE OF. C. F. Broadhead, Nestlebrae, Junction Road, Clayfield, near Brisbane, Australia. International Convention (Australia), January 7, 1918.

The process is for the simultaneous manufacture of mixed coal and water gas, and a low-temperature production of tar oil. A water gas generator is surmounted by a vertical retort tapering towards the top, and fire-bars are provided at the bottom of the generator. The generator is initially filled with hot coke, and the retort is filled with coal resting on the coke. The coke is raised to incandescence by blowing air through it and the resulting gas passes upwards through checker brickwork surrounding the retort to heat the coal in the latter and generate gas. The air is then shut off and steam is blown through the coke to generate water gas which passes upwards through the coal and subjects it to low temperature carbonisation, and the mixture of coal and water gas passes out through a valve at the top of the retort. Coal is fed into the retort from a hopper at the top intermittently between each successive steam run. The tar may be collected in the usual way.

140,831. CHLORHYDRINS, MANUFACTURE OF. R. Haddan, London. (From The Commercial Research Co., Jackson Avenue, and Honeywell Street, Long Island City, N.Y., U.S.A.) Application date, February 27, 1917.

Olefins are treated in an electrolytic cell in which chlorine has been generated to produce chlorhydrins. An electrolytic cell of ordinary type containing sodium chloride solution is maintained at about 95° to 100° C., and steam and oil gas are blown through the anode chamber of the cell. A large excess of steam is used, and the vapour containing chlorhydrins and hydrochloric acid is passed through a condenser. The hydrochloric acid condensed is returned to the cell thereby lowering the voltage required for the electrolysis, and the chlorhydrins are also condensed and removed. In a modification the sodium chloride solution in the anode chamber is saturated with gaseous olefins and then electrolysed. The chlorhydrins formed pass into solution and finally separate as an oily layer.

140,833. AMMONIA, CATALYTIC OXIDATION OF. M. Taliani, Isola Liri (Caserta), Italy. Application date, April 8, 1918.

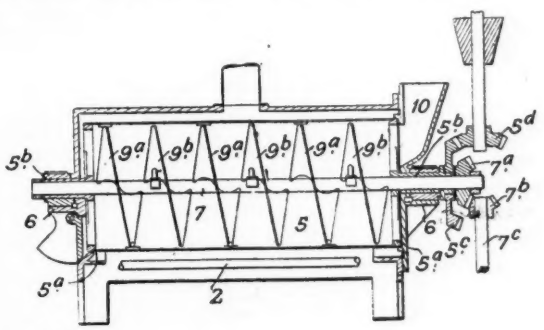
A catalyst consisting of broken porcelain coated with metallic platinum is supported on a tubular grating through which water is passed. The catalyst forms a horizontal partition in the reaction chamber, and a mixture of air and ammonia gas which is previously given a whirling motion is passed into the lower part of the casing which tapers downwards. The mixture passes upwards through the catalyst and oxides of nitrogen are produced; the necessary temperature is maintained by the heat of the reaction when once started. The pressure in the chamber is controlled by a valve in the upper part, which tapers upwards. Radiation of heat from the catalyst into the gas mixture below is prevented by the water-cooled grating.

140,844. SULPHUR, PURIFICATION OF. J. J. Hood, 4, Canonbury Park North, London, N. 1. Application date, November 27, 1918.

The object is to obtain sulphur of high purity from crude sulphur containing pitch or other carbonaceous material, or from crude sulphur obtained by leaching spent oxide from gas works. The sulphur is melted and filtered through precipitated and ignited tri-hydrate of alumina, or precipitated and ignited magnesia. Alternatively bauxite or magnesite may be used as a starting material. The filtering material may be regenerated by passing steam or a sulphur solvent through it and then igniting the residue. Spent oxide may be treated with carbon bisulphide or other sulphur solvent, and the sulphur solution then filtered through ignited bauxite or magnesite. The filtering material may be regenerated as above.

140,880. ROASTING, MIXING OR SIMILAR OPERATIONS, MEANS FOR FEEDING MATERIAL THROUGH A ROTATING CYLINDER WHILST SUBJECTED TO. A. Sonsthagen, 35, Drayton Grove, West Ealing, London, W. 13. Application date, February 17, 1919.

The roasting or mixing drum 5 is arranged in a casing and is heated by a gas or other heater 2. The drum 5 carries annular members 5*a* forming part of hollow trunnions 5*b* which are supported in bearings 6 formed in the ends of the casing, and one of the trunnions carries a bevel wheel 5*c* meshing with another bevel wheel 5*d*, which is driven by any source of power. A concentric shaft 7 passes through the hollow trunnions and carries a bevel wheel 7*a* meshing with



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another bevel wheel 7*b* driven by another shaft 7*c*. The shaft 7 carries helical blades 9*b*, and the drum 5 carries similar blades 9*a*, the two series forming a worm extending the full length of the drum. The material to be treated is fed through the hopper 10, and the two series of blades are driven at different speeds, or one series may be driven in the opposite direction to that of the other; one series of blades thus moves the material forward while the other checks it or moves it backwards, thus causing a thorough mixing. By varying the relative speeds of the two driving shafts any desired rate of progression may be obtained. Alternatively, the pitch of the blades of one series may be less and in the opposite direction to that of the other series.

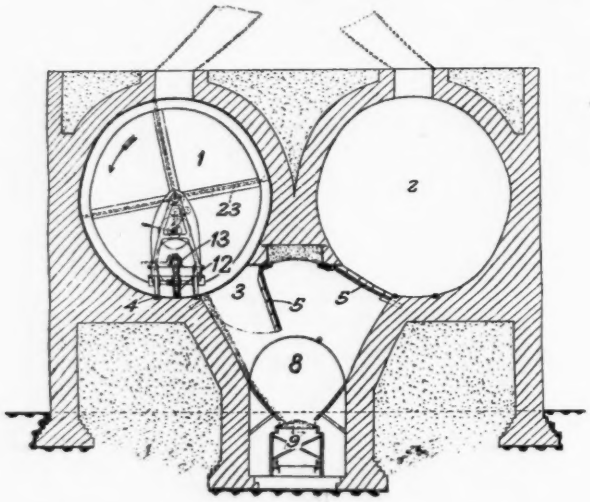
140,891. GAS GENERATORS AND THE LIKE, APPARATUS FOR AGITATING THE FUEL IN AND MEANS FOR OPERATING THE SAME. G. H. Bentley and E. G. Appleby, 12, The Broadway, Westminster, London, S.W. 1. Application date, March 13, 1919.

The pokers for stirring the fuel in a gas generator are provided with toothed racks and are carried by a frame at the top of the generator. The frame may be rotated by means of a driving pinion gearing with a rack at its base. The vertical rack carried by the poker gears with a toothed quadrant on a lever pivoted to the frame and carrying a weight which balances the poker, so that it rises and falls in accordance with the height of the fuel bed.

140,915. SUPER-PHOSPHATE MANURES, APPARATUS FOR THE MANUFACTURE OF. H. Jones and Ernest Newell & Co., Ltd., Misterton, near Gainsborough. Application date, May 3, 1919.

The object is to improve the construction of the chambers or dens in which super-phosphate manure is made. Two horizontal cylindrical dens 1 and 2 are arranged side by side

in a casing and are worked alternately. The longitudinal discharge opening 3 is arranged wholly in the lower portion of one side of each den, the two openings being adjacent as shown. Each opening is provided with a door 5 pivoted between the dens in such a way that when open it hangs at an angle to the vertical as shown. A conveyor 9 is arranged in a channel 8 to receive and convey away the super-phosphate when discharged. To discharge the super-phosphate a rotary excavator is mounted on wheels running on the rails 4, and is capable of movement through the full length of each den. The cutting arms 23 are rotated by gearing from a longitudinal shaft which may be clutched to the worm 13. The excavator is moved longitudinally by the rotation of the worm 13 which rotates the worm wheel 12, which is mounted on the back axle of the excavator. The means for driving the worm 13 from a transverse power shaft is described in detail. A carriage is



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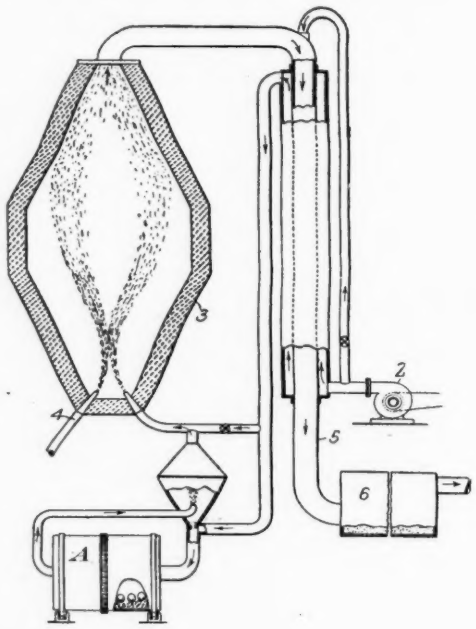
provided running transversely in front of the two dens, so that the excavator may be transported from one den to the other and may be advanced into either den. The direction of rotation of the cutters is from the lower to the upper edge of the discharge opening 3, so that the cut super-phosphate is carried round to a position vertically above the axis and then drops on to the back of the preceding cutter so that it is only swept a short distance across the base of the den to the discharge opening. The backs of the cutters are extended backwards from their cutting edges to form carriers or sweeps. The cutters may be inclined to the surface which is being cut, and means are provided to enable their angle of inclination to be reversed when the excavator is operating in the second den. When the excavator reaches the further end of the den its rotation is stopped, and it is automatically withdrawn from the den at an accelerated rate.

140,943. ORES OR CONCENTRATES, ROASTING OF. U. C. Tainton, 1414, Richardson Street, Martinez, Cal., U.S.A. Application date, June 13, 1919.

The apparatus is for roasting complex ores or concentrates in the form of a fine powder by means of an air blast and is more particularly for roasting zinc ores containing iron. In the usual method of roasting such ores, the zinc oxide combines with the iron oxide at about 900°F., forming a compound which is insoluble in sulphuric acid in which the ore is subsequently leached, so that some of the zinc is not recovered. To avoid this difficulty the material to be roasted is ground to a very fine powder in a ball mill A, *e.g.*, 100 to 150 mesh, and the particles are carried forward by a current of air produced by a fan 2 and injected into the furnace 3. The furnace is maintained at a high temperature either by the heat of the burning ore alone or by auxiliary heat from an oil burner 4. The incoming air may be preheated to about 500°C. by passing it around the discharge pipe 5 to the furnace. The circulation of the air and its mixture with the powder are indicated by arrows. The furnace chamber is sufficiently large to allow complete oxidation of the sulphide without contact of the individual particles of iron and zinc oxide. The roasted particles, still in suspension, pass downwards through the pipe 5, in which they are cooled by the incoming air to a temperature at which combination does not occur. The mixed



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oxides are separated in dust chambers 6 or by centrifugal separators, filter bags, or electrostatic precipitation. The process is applicable to other complex ores with which difficulties are usually experienced in the subsequent leaching, *e.g.*, copper ores containing iron.

141,001. CONTINUOUS VACUUM FILTERS. A. E. Alexander, London. (From United Filters Corporation, 36, Flatbush Avenue Extension, Brooklyn, N.Y., U.S.A.) Application date, December 30, 1918.

Specification 136,309 (*See* THE CHEMICAL AGE, Vol. II., page 76) describes a continuous vacuum filter in which a series of vertical filter discs divided radially into sectors are mounted on a horizontal rotating shaft, and each sector is separately connected to corresponding longitudinal pipes within the central shaft. In the present specification the central supporting shaft is of sectionalised construction, and is composed of a number of separate longitudinal pipes, each of which communicates with the interior of the corresponding filter sector. The arrangement for assembling the pipes and connecting the filtering sectors is described in detail

International Specifications Not yet Accepted

138,915. TREATING INDIARUBBER. Hunter Dry Kiln Co., 2571, Cornell Avenue, Indianapolis, Ind., U.S.A. (Assignees of H. Hunter, 2802, Ashland Avenue, Indianapolis, Ind., U.S.A.). International Convention date, July 2, 1919.

Indiarubber is exposed in flat trays to the action of a current of moist air at a temperature of 110°-170°F. The process is primarily for drying the rubber, but it may be employed at all stages from the latex to the final form.

139,153. OXYALDEHYDES. A. Weiss, 14, Rue Pasteur, Lyons, France. International Convention date, February 18, 1919.

A phenol or its ether is mixed with formaldehyde and treated with a nitroso compound to produce oxyaldehydes and their ethers. As an example, a mixture of guaiacol and formaldehyde is treated with *p*-nitrosodimethylaniline to produce vanillin.

139,156. DECOLORISING CARBON. C. S. Hudson, 25, Laselle Avenue, Trenton, N.J., U.S.A. International Convention date, February 15, 1919.

Organic material such as sawdust, corn-cobs, or scrap leather, is heated to 400°-600°C. with one half to twice the amount of phosphoric or boric acid. The acid is afterwards removed by leaching.

139,462. FERTILISERS. Norsk Hydro-Elektrisk Kvaelstofaktieselskab, 7, Solligaten, Christiania. International Convention date, February 24, 1919.

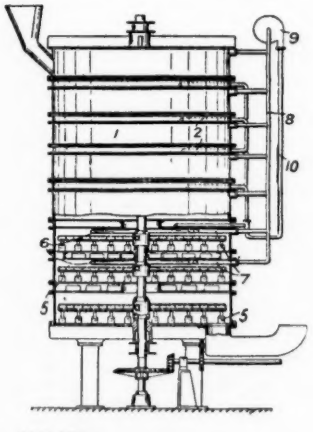
Urea nitrate is mixed with powdered limestone or marble for use as a fertiliser.

139,470. ALUMINIUM SALTS. Norske Aktieselskab for Elektrokemisk Industri Norsk Industri-Hypotekbank, 24, Toldbodgaten, Christiania. International Convention date, February 22, 1919.

The process is for precipitating in a filterable form the iron present in impure solutions of aluminium salts. The iron is precipitated by adding aluminium oxide or hydrate, dolomite or other carbonate, or bases such as calcium oxide, hydrate, or carbonate, and the acid resulting from the hydrolysis of the aluminium salts is only partly neutralised. The physical condition of the precipitated iron depends on the temperature of the solution and its acidity after adding the precipitating material. The precipitation of the iron is facilitated by adding iron oxide or hydrate, which may be that obtained by this process.

139,478. DRYING ORE CONCENTRATES. G. Schjelderup, Christiania. International Convention date, February 24, 1919.

A vertical cylindrical casing contains a series of alternate drying chambers 1 and heating chambers 2. The material to be dried is fed on to the floor of the uppermost drying chamber and is transferred to the chamber next below by means of a rotating scraper 5, mounted on a central vertical shaft. The drying chambers communicate with one another by openings which are alternately at the centre and the circumference.



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The vapour from the drying chambers is withdrawn through annular perforated pipes 6 by a fan 9 and then forced through pipes 10 into the heating chambers 2. The heat necessary for drying is wholly or partly obtained from the heat generated in the chambers 2 by the compression of the vapour, the heat being transferred through the partitions to the drying chambers. Drying may be facilitated by preheating the material or by mixing it with hot material previously dried. In an alternative form, the material may be carried on a travelling belt moving over the drying chamber floors.

139,488. DRYING COLLOIDS. G. P. Lunt, 22, Evans Way, Boston, Mass., U.S.A. International Convention date, April 7, 1916.

The apparatus is for removing solvents from colloid substances, such as nitrocellulose explosives or indiarubber. The material to be treated is placed on shelves heated by hot water pipes and contained in a chamber which is connected at the bottom with a circulating pump. The solvent is evaporated by means of a gas, such as carbon dioxide or sulphur dioxide, which does not form an explosive mixture with it, and which is forced upwards through the chamber. The vapour-laden gas then passes to a condenser provided with jets of the solvent liquid or one of its constituents, and the solvent vapour is thus condensed. The gas passes on to the circulating pump, so that it circulates in a closed circuit. By suitably regulating the temperature and volume of the condensing liquid, the amount and proportions of the solvent recovered may be regulated, so that the solvent in the colloid evaporates at the same rate that it diffuses through the colloid and " blistering " is avoided.

139,511. PULVERISING MILLS. Fuller-Lehigh Co., Fullerton, Pa., U.S.A. (Assignees of J. W. Fuller, Catasauqua, Pa., U.S.A.). International Convention date, August 27, 1917.

The pulverising mill is of the type in which heavy grinding balls are propelled around a horizontal trough by means of a rotating frame carried by a vertical shaft. The rotating frame carries scoops for lifting the pulverised material, arranged alternately with the balls. The frame also carries radial blades which force the material received from the scoops through a cylindrical screen arranged above the pulverising zone. The scoops may be arranged so as to lift the material towards the periphery or the axis of the screen to effect coarse grinding or fine grinding respectively.

LATEST NOTIFICATIONS.

142,081. Solid basic magnesium hypochlorite, Process for the production of. G. Kereszty and E. Wolf. April 19, 1919.

142,122. Cyanogen compounds, Manufacture of. H. Mehner. October 9, 1914.

Specifications Accepted, with Date of Application

117,083. Gasification of carboniferous substances, Process and apparatus for. H. Strache. June 28, 1916.

120,382. Aromatic arsenical compounds. Rockefeller Institute for Medical Research. October 3, 1917.

122,192. Hydrogenation processes, Production of catalysts suitable for use in. W. P. Schuck. January 9, 1918.

123,719. Hydrocarbons, Rectification of. De Bataafsche Petroleum-Maatschappij and J. H. C. de Brey. March 1, 1918.

133,012. Mono-azo dystuffs, Manufacture and production of new. Farbenfabriken vorm. F. Bayer & Co. July 25, 1916.

141,089. Mineral distillates of definite composition, Furnaces for the production of. W. J. Fadden. October 7, 1918.

141,093. Sulphate of ammonia from distillation and like gases containing ammonia, Production of. E. C. R. Marks. (*Soc. Franco-Belge de Fours a Coke.*) November 28, 1918.

141,097. Gases, Apparatus for cooling. J. A. Reavell and Kestner Evaporator & Engineering Co. December 4, 1918.

141,124-5. Gas, coal and oil-fired continuous kilns and dryers of tunnel and car type. F. Fidler and J. G. Maxwell. January 6, 1919.

141,132. Open-hearthed furnaces. W. Waring. January 8, 1919.

141,172. Revivifying spent oxide. W. J. Dibdin. March 15, 1919.

141,210. Volatile solvents, Recovery of. D. V. Plumbridge. May 14, 1919.

141,223. Hydrocarbons, Method of and apparatus for treating —for the production of lighter hydrocarbons. B. Andrews and W. C. Averill. May 27, 1919.

141,272. Desulphurising sulphur-bearing hydrocarbons, Process for. Hall Motor Fuel, Ltd., and T. A. McCrea. September 8, 1919.

141,290. Copper from lyes resulting from the treatment of cupriferous pyrites, Process for obtaining. H. P. Soulie-Cottineau. October 31, 1919.

141,305. Electrolysers. G. G. Hepburn. February 22, 1919.

Market Report and Current Prices

Our Market Report and Current Prices are exclusive to THE CHEMICAL AGE, *and, being independently prepared with absolute impartiality by Messrs. R. W. Greeff & Co. and Messrs. Chas. Page & Co., Ltd., may be accepted as authoritative. The prices given apply to fair quantities delivered ex wharf or works, except where otherwise stated. The weekly report contains only commodities whose values are at the time of particular interest or of a fluctuating nature. A more complete report and list are published once a month. The current prices are given mainly as a guide to works managers, chemists, and chemical engineers; those interested in close variations in prices should study the market report.*

Market Report

THURSDAY, May 6.

Business has again been satisfactory, and the demand continues for the majority of chemicals. The scarcity of stocks is becoming very noticeable, and supplies for prompt delivery are mostly at a premium.

Export business is quieter, and on the whole this is not due to any falling off in the actual demand for chemicals, but more to shortage of supplies, and difficulties in connection with the exchanges. The new French export prohibition tends to restriction of export business over all the market, while the far Eastern demand shows some signs of slackening.

General Chemicals

ACETONE is in active request and very firm in price.

ACID ACETIC is again higher in price, and difficult to obtain for either prompt or forward delivery.

ACID CARBOLIC is quietly steady. Some second-hand parcels have been offered, but in the main at prices on a parity with makers' quotations.

ACID CITRIC is quiet, but the undertone is firm.

ACID FORMIC is in good inquiry, and is slightly firmer.

ACID LACTIC is easier, and sellers are inclined to make concessions.

ACID OXALIC is firm, and there is very little spot available.

ACID TARTARIC.—Holders are still inclined to take their profit, but with the English makers sold out and foreign makers holding to their quotations it is expected that an improvement will be seen before long.

AMMONIUM SALTS are all very firm in price, and there has been a sharp advance in the makers' quotations for muriate. It is difficult to work prompt delivery, and with the uncertain outlook makers are not inclined to sell forward.

ARSENIC is in quiet demand, but the price is steady.

BARIUM SALTS are moving off fairly well. Chloride is becoming very scarce, and is particularly firm in price.

BLEACHING POWDER is unchanged, but is only a nominal market, as supplies are practically unobtainable.

COPPER SULPHATE continues with practically no inquiry.

CREAM OF TARTAR.—Owing to the realisation of certain stocks, which have lately come on the market, the position is easier, but improvement in the near future is not unlikely.

FORMALDEHYDE.—The easier tendency which was observed last week appears to have disappeared, and the article is now as firm as ever, and little is offering for near delivery.

LEAD SALTS are inclined to be firmer, and a slightly improved business is passing.

LITHOPONE is in better request, but price is without change. There is little more offering.

MAGNESIUM SALTS are all very active and scarce, particularly sulphate.

POTASSIUM BICHROMATE.—Second-hand parcels which appear from time to time are readily absorbed at high figures.

POTASSIUM CHLORATE is very slow and inclined to be easier.

POTASSIUM NITRATE is in good demand at makers' quotations.

POTASSIUM PERMANGANATE continues in good request, and small available supplies are firmly held for full prices.

POTASSIUM PRUSSIATE is firmly held, and supplies are on the short side. Very little foreign material is now arriving.

SODIUM ACETATE is without change in price, and the demand seems to have quietened somewhat.

SODIUM CAUSTIC is quiet on export account, but visible supplies are small, and with any increase in the demand the price will quickly respond.

SODIUM HYPOSULPHITE.—Makers are fully sold out and little or nothing is available in second-hands. High prices continue to be paid for odd parcels.

SODIUM NITRITE is in strong request, and business is passing at high figures for spot parcels.

SODIUM PRUSSIATE is easier, and there appears to be more material available on the market. Makers, however, appear to be well occupied with business.

SODIUM SULPHIDE.—Second-hand parcels continue to change hands at remarkable prices, and business is only restricted by the limited supplies. Values, however, appear to be now getting dangerously high.

TIN SALTS remain quiet and uninteresting.

Coal Tar Intermediates

A very active business has been passing in this section, and all prices continue extremely firm, and what changes there are are in the upward direction.

ALPHA NAPHTHOL.—English makers are fully occupied, and are now disinclined to accept more business for future positions.

ALPHA NAPHTHYLAMINE is in short supply, and price is very firm.

ANILINE OIL AND SALT are both in demand, and the price is very firm. Some few export licences appear to have been granted.

BETA NAPHTHOL continues extremely scarce, and fancy prices are paid for any odd parcels appearing on the market.

DIMETHYL ANILINE is in request, but practically nothing is obtainable.

DIPHENYLAMINE is wanted, but is in only short supply.

PARANITRANILINE is extremely scarce, and very little is available for near delivery.

XYLIDINE has been inquired for, but only small supplies are available.

Coal Tar Products

There is no change to report.

90's BENZOL is worth about 2s. 8d. on rails.

CREOSOTE OIL remains unchanged at 1s. 1d. in the North, and 1s. 2d. to 1s. 2½d. in the South.

SOLVENT NAPHTHA is worth 2s. 9d. per gallon.

HEAVY NAPHTHA.—The price is about 3s. 3d. to 3s. 6d. per gallon.

NAPHTHALENE is still scarce, crude being worth £14 to £18 per ton, and refined from £36 to £40 per ton.

PITCH.—The market is steady, but somewhat inactive. There is no change in the quotations.

Sulphate of Ammonia

The position is quite unchanged.

Current Prices

Chemicals

	per	£	s	d.		£	s.	d.
Acetic anhydride	lb.	0	3	6	to	0	3	9
Acetone oil	ton	85	0	0	to	90	0	0
Acetone, pure	ton	120	0	0	to	125	0	0
Acid, Acetic, glacial, 99-100%	ton	120	0	0	to	122	10	0
Acetic, 80% pure	ton	97	0	0	to	98	10	0
Arsenic	ton	100	0	0	to	105	0	0
Boric, cryst.	ton	74	10	0	to	76	0	0
Carbolic, cryst. 39-40%	lb.	0	1	3½	to	0	1	4
Citric	lb.	0	7	0	to	0	7	3
Formic, 80%	ton	120	0	0	to	125	0	0
Gallic, pure	lb.	0	7	3	to	0	7	9
Hydrofluoric	lb.	0	0	7	to	0	0	8
Lactic, 50 vol.	ton	65	0	0	to	70	0	0
Lactic, 60 vol.	ton	80	0	0	to	85	0	0
Nitric, 80 Tw.	ton	40	0	0	to	42	0	0
Acid, Oxalic	lb.	0	3	0	to	—		
Phosphoric, 1.5	ton	60	0	0	to	65	0	0
Pyrogallic, cryst	lb.	0	11	6	to	0	11	9
Salicylic, Technical	lb.	0	3	0	to	0	3	3
Salicylic, B.P.	lb.	0	3	9	to	0	4	0
Sulphuric, 92-93%	ton	7	15	0	to	8	5	0
Tannic, commercial	lb.	0	5	0	to	0	5	3
Tartaric	lb.	0	4	0	to	0	4	2
Alum, lump	ton	19	10	0	to	20	0	0
Alum, chrome	ton	93	0	0	to	95	0	0

	per	£	s.	d.		£	s.	d.
Alumino ferric	ton	9	0	0	to	9	10	0
Aluminium, sulphate, 14-15%	ton	17	10	0	to	18	10	0
Aluminium, sulphate, 17-18%	ton	20	10	0	to	21	10	0
Ammonia, anhydrous	lb.	0	1	9	to	0	2	0
Ammonia, .880	ton	32	10	0	to	37	10	0
Ammonia, .920	ton	20	0	0	to	24	0	0
Ammonia, carbonate	lb.	0	0	7½	to		—	
Ammonia, chloride	ton	115	0	0	to	120	0	0
Ammonia, muriate (galvanisers)	ton	55	0	0	to	60	0	0
Ammonia, nitrate	ton	60	0	0	to	65	0	0
Ammonia, phosphate	ton	135	0	0	to	140	0	0
Ammonia, sulphocyanide	lb.	0	2	3	to	0	2	6
Amyl, acetate	ton	360	0	0	to	370	0	0
Arsenic, white, powdered	ton	67	10	0	to	70	0	
Barium, carbonate	ton	13	10	0	to	14	10	
Barium, carbonate, 92-94%	ton	14	10	0	to	15	0	0
Chlorate	lb.	0	1	4	to	0	1	5
Chloride	ton	36	0	0	to	37	0	0
Barium, Nitrate	ton	55	0	0	to	56	0	0
Sulphate, blanc fixe, dry	ton	25	10	0	to	26	0	0
Sulphate, blanc fixe, pulp	ton	15	10	0	to	16	0	0
Bleaching powder, 35-37%	ton	18	10	0	to	19	10	0
Borax crystals	ton	41	0	0	to	42	10	0
Calcium acetate, Brown	ton	20	0	0	to	21	0	0
,, Grey	ton	41	0	0	to	42	10	0
Carbide	ton	30	0	0	to	32	0	0
Chloride	ton	9	10	0	to	10	10	0
Carbon bisulphide	ton	58	0	0	to	59	0	0
Casein, technical	ton	80	0	0	to	83	0	0
Cerium oxalate	lb.	0	3	9	to	0	4	0
Chromium acetate	lb.	0	1	2	to	0	1	4
Cobalt acetate	lb.	0	7	0	to	0	7	6
Oxide, black	lb.	0	7	9	to	0	8	0
Copper chloride	lb.	0	1	3	to	0	1	6
Sulphate	ton	46	0	0	to	47	0	0
Cream Tartar, 98-100%	ton	305	0	0	to	310	0	0
Epsom salts (*see* Magnesium sulphate)								
Formaldehyde 40% vol	ton	350	0	0	to	355	0	0
Formusol (Rongalite)	lb.	0	4	0	to	0	4	3
Glauber salts	ton	5	0	0	to	5	10	0
Glycerine, crude	ton	70	0	0	to	72	10	0
Hydrogen peroxide, 12 vols.	gal.	0	2	8	to	0	2	9
Iron perchloride	ton	50	0	0	to	52	0	0
Iron sulphate (Copperas)	ton	4	15	0	to	5	0	0
Lead acetate, white	ton	95	0	0	to	100	0	0
Carbonate (White Lead)	ton	75	0	0	to	77	10	0
Nitrate	ton	75	0	0	to	80	0	0
Litharge	ton	62	10	0	to	65	0	0
Lithopone, 30%	ton	60	0	0	to	62	0	0
Magnesium chloride	ton	15	10	0	to	16	10	0
Carbonate, light	cwt	2	15	0	to	3	0	0
Sulphate (Epsom salts commercial)	ton	14	0	0	to	14	10	0
Sulphate (Druggists')	ton	18	10	0	to	19	10	0
Manganese, Borate	ton	190	0	0	to		—	
Sulphate	ton	105	0	0	to	110	0	0
Methyl acetone	ton	95	0	0	to	100	0	0
Alcohol, 1% acetone	gall.	Nominal						
Nickel ammonium sulphate, single salt	ton	50	0	0	to	52	10	0
Potassium bichromate	lb.	0	2	2	to	0	2	3
Potassium Carbonate, 90%	ton	102	0	0	to	105	0	0
Chloride	ton	Nominal.						
Chlorate	lb.	0	0	10	to	0	0	10½
Meta-bisulphite, 50-52%	ton	270	0	0	to	280	0	0
Nitrate, refined	ton	72	0	0	to	75	0	0
Permanganate	lb.	0	6	6	to	0	6	9
Prussiate, red	lb.	0	6	3	to	0	6	6
Prussiate, yellow	lb.	0	2	4	to	0	2	5
Sulphate, 90%	ton	31	0	0	to	33	0	0
Salammoniac, firsts	cwt.	5	15	0	to		—	
Seconds	cwt.	6	0	0	to		—	
Sodium acetate	ton	66	0	0	to	67	0	0
Arsenate, 45%	ton	60	0	0	to	62	0	0
Bicarbonate	ton	10	10	0	to	11	0	0
Bichromate	lb.	0	2	0	to	0	2	1
Bisulphite, 60-62%	ton	47	10	0	to	50	0	0
Chlorate	lb.	0	0	5½	to	0	0	6½
Caustic, 70%	ton	43	10	0	to	44	10	0
Caustic, 76%	ton	44	10	0	to	45	10	0
Sodium, Hydrosulphite, powder, 85%	lb.	0	3	9	to	0	4	0
Hyposulphite, commercial	ton	35	0	0	to	40	0	0
Nitrite, 96-98%	ton	125	0	0	to	130	0	0
Phosphate, crystal	ton	40	0	0	to	42	0	0
Perborate	lb.	0	2	2	to	0	2	4
Prussiate	lb.	0	1	10	to	0	1	10½
Sulphide, crystals	ton	28	0	0	to	30	0	0
Sulphide, solid, 60-62%	ton	51	0	0	to	52	0	0
Sulphite, cryst.	ton	14	10	0	to	15	10	0
Strontium carbonate	ton	85	0	0	to	90	0	0
Nitrate	ton	90	0	0	to	95	0	0
Sulphate, white	ton	8	10	0	to	10	0	0
Sulphur chloride	ton	42	0	0	to	44	10	0
Sulphur, Flowers	ton	25	0	0	to	27	0	0
Roll	ton	24	0	0	to	26	0	0
Tartar emetic	lb.	0	3	5	to	0	3	6
Tin perchloride, 33%	lb.	0	2	6	to	0	2	7
Perchloride, solid	lb.	0	3	0	to	0	3	3
Protochloride (tin crystals)	lb	0	1	11	to	0	2	0
Zinc chloride, 102 Tw.	ton	22	0	0	to	23	10	0
Chloride, solid, 96-98%	ton	60	0	0	to	65	0	0
Oxide, 99%	ton	82	10	0	to	85	0	0
Oxide, 94-95%	ton	70	0	0	to	72	10	0
Dust, 90%	ton	90	0	0	to	92	10	0
Sulphate	ton	21	10	0	to	23	10	0

Coal Tar Intermediates, &c.

Alphanaphthol, crude	lb.	0	4	0	to	0	4	3
Alphanaphthol, refined	lb.	0	5	0	to	0	5	3
Alphanaphthylamine	lb.	0	3	9	to	0	4	0
Aniline oil, drums extra	lb.	0	1	5	to	0	1	6
Aniline salts	lb.	0	1	10	to	0	2	0
Anthracene, 85-90%	lb.		—		to		—	
Benzaldehyde (free of chlorine)	lb.	0	5	6	to	0	6	0
Benzidine, base	lb.	0	12	6	to	0	13	6
Benzidine, sulphate	lb.	0	10	0	to	0	11	0
Benzoic, acid	lb.	0	5	6	to	0	6	0
Benzoate of soda	lb.	0	5	6	to	0	6	0
Benzyl chloride, technical	lb.	0	2	0	to	0	2	3
Betanaphthol benzoate	lb.	1	6	0	to	1	7	6
Betanaphthol	lb.	0	5	0	to	0	5	3
Betanaphthylamine, technical	lb.	0	8	6	to	0	9	6
Croceine Acid, 100% basis	lb.	0	5	0	to	0	6	3
Dichlorbenzol	lb.	0	0	6	to	0	0	7
Diethylaniline	lb.	0	7	9	to	0	8	6
Dinitrobenzol	lb.	0	1	5	to	0	1	6
Dinitrochlorbenzol	lb.	0	1	5	to	0	1	6
Dinitronaphthaline	lb.	0	1	4	to	0	1	6
Dinitrotoluol	lb.	0	1	8	to	0	1	9
Dinitrophenol	lb.	0	3	6	to	0	3	9
Dimethylaniline	lb.	0	4	9	to	0	5	0
Diphenylamine	lb.	0	4	9	to	0	5	0
H-Acid	lb.	0	13	6	to	0	14	0
Metaphenylenediamine	lb.	0	5	9	to	0	6	0
Monochlorbenzol	lb.	0	0	10	to	0	1	0
Metanilic Acid	lb.	0	7	6	to	0	8	6
Monosulphonic Acid (2:7)	lb.	0	7	6	to	0	8	0
Naphthionic acid, crude	lb.	0	5	6	to	0	6	0
Naphthionate of Soda	lb.	0	6	0	to	0	6	6
Naphthylamin-di-sulphonic-acid	lb.	0	5	6	to	0	6	6
Nitronaphthaline	lb.	0	1	3	to	0	1	4
Nitrotoluol	lb.	0	1	4	to	0	1	6
Orthoamidophenol, base	lb.	0	18	0	to	1	0	0
Orthodichlorbenzol	lb.	0	1	2	to	0	1	3
Orthotoluidine	lb.	0	2	6	to	0	2	9
Orthonitrotoluol	lb.	0	1	8	to	0	1	10
Para-amidophenol, base	lb.	0	15	0	to	0	16	0
Para-amidophenol, hydrochlor	lb	0	15	6	to	0	16	0
Paradichlorbenzol	lb.	0	0	6	to	0	0	8
Paranitraniline	lb.	0	8	3	to	0	8	9
Paranitrophenol	lb.	0	2	6	to	0	2	9
Paranitrotoluol	lb.	0	5	3	to	0	5	6
Paraphenylenediamine, distilled	lb.	0	13	6	to	0	14	6
Paratoluidine	lb.	0	7	6	to	0	8	6
Phthalic anhydride	lb.	0	5	6	to	0	6	0
R. Salt, 100% basis	lb.	0	4	0	to	0	4	2
Resorcin, technical	lb.	0	11	6	to	0	12	6
Resorcin, pure	lb.	0	17	6	to	1	0	0
Salol	lb.	0	5	9	to	0	6	0
Shaeffer acid, 100% basis	lb.	0	3	6	to	0	3	0
Sulphanilic acid, crude	lb.	0	1	5	to	0	1	6
Tolidine, base	lb.	0	10	6	to	0	11	6
Tolidine, mixture	lb.	0	3	0	to	0	3	6

Building Materials

Bricks, stock	1000	4	12	0	to	4	16	0
Bricks, blue Staffs.	1000	10	5	0	to	10	8	0
Firebricks, Stourbridge	1000	11	10	0	to	11	15	0
Fireclay, Stourbridge	ton	2	3	0	to	2	5	0
Glass, sheet, 21 oz.	ft.	0	0	9	to	0	0	9½
Lime, ground blue Lias	ton	2	15	0	to	2	16	0
Lime, grey stone	ton	3	0	0	to	3	2	6
Linseed oil, boiled	gall.	0	11	0	to	0	11	3
Linseed oil, raw	gall.	0	10	6	to	0	10	9
Portland cement	ton	3	19	0	to	4	3	0
Slates, Bangor (First quality)	1200	40	0	0	to	41	0	0
Slates, Portmadoc (First quality)	1200	22	0	0	to	23	0	0
Tiles	1000	6	18	0	to	7	1	0
Turpentine	gall.	0	18	6	to	19	0	0
Deal, up to 3×8	standard	45	0	0	to	46	0	0
Deal, over 3×8	standard	46	0	0	to	55	0	0

Miscellaneous and Paint Materials

	per	£	s.	d.		£	s.	d.
Barytes	ton	11	0	0	to	13	0	0
Casein	ton	75	0	0	to	80	0	0
Chalk, precipitated (light)	ton	20	0	0	to	24	0	0
Chalk, precipitated (heavy)	ton	10	0	0	to	12	0	0
China clay (bags extra) (f.o.r. Cornwall)	ton	1	12	6	to	3	12	6
Coke, blast furnace (S. Wales)	ton	2	13	0	to	3	5	0
Coke, foundry (S. Wales)	ton	3	5	0	to	4	0	0
Fuller's Earth	ton	4	0	0	to	5	0	0
Lead, litharge flake	ton	64	10	0	to	67	10	0
Lead, red	cwt.	3	5	0	to	3	7	6
Lead, white	cwt.	3	15	0	to	3	17	6
Ultramarine	ton	90	0	0	to	110	0	0
Prussian Blue	cwt.	13	0	0	to	14	10	0
Chrome green	cwt.	6	5	0	to	6	10	0
Chrome yellow	cwt.	6	5	0	to	7	0	0
Mineral black	ton	10	10	0	to	12	0	0
Carbon black	lb.	0	1	3	to	0	1	6
Guignet's Green, 30%	lb.	0	1	7	to	0	1	9

The following prices are furnished by Messrs. Miles, Mole & Co., Ltd., 101, Leadenhall Street, London, E.C.

Metals and Ferro-Alloys

	per	£	s.	d.		£	s.	d.
Aluminium, 98-99%	ton	165	0	0	to	166	0	0
Antimony, English	ton	72	0	0	to	72	10	0
Copper, best selected	ton	113	0	0	to	113	10	0
Ferro Chrome, 60%	ton	45	0	0	to	45	10	0
Manganese, 76-80%	ton	37	0	0	to	38	0	0
Silicon, 45-50%	ton	25	0	0	to	26	0	0
Tungsten, 75-80%	lb.	0	3	3	to	0	3	6
Lead Ingot	ton	40	0	0	to	40	10	0
Sheets	ton	57	0	0	to	58	0	0
Nickel, 98-99%	ton	230	0	0	to	231	0	0
Tin	ton	342	0	0	to	343	0	0
Zinc Sheet	ton	80	0	0	to	81	0	0
Spelter	ton	52	0	0	to	53	0	0

Structural Steel

	per	£	s.	d.		£	s.	d.
Angles and Tees	ton	25	0	0	to	32	0	0
Flats and rounds	ton	27.	0	0	to	32	0	0
Joists	ton	25	0	0	to	32	0	0
Plates	ton	26	0	0	to	32	0	0
Rails, heavy	ton	23	0	0	to	25	0	0
Sheets, 24 Gauge	ton	40	0	0	to	42	0	0
Galvd. Corrd. Sheets	ton	56	0	0	to	57	0	0

Manchester Chemical Trade

SIR S. W. ROYSE & CO., LTD., in their monthly circular state :—Business has been checked this month by the Easter holidays and also by uncertainty as to the Budget proposals. Now that the latter are more or less known, it remains to be seen what effect they will have on trade. The further demands of labour and the position in regard to fuel have also been disturbing factors. Nevertheless, all things considered, a satisfactory business has been done during the month. The demand from abroad for sulphate of copper continues dull, although the returns show 3,850 tons exported last month against 3,240 tons for March of last year. There is a better enquiry for home consumption. A good business has been passing in green copperas on export account and price is higher. Acetate of soda has been steadily enquired for and is in rather short supply. Acetates of lead are somewhat easier in sympathy with the lower prices for the metal. Nitrate of lead is offering at reduced figures and good business passing. Carbonate of potash is scarce and price is steady. Montreal potashes are offering only in small quantities and stocks in Canada are reported light. White powdered arsenic is unchanged though there is some pressure to sell for delivery ahead. There has been a slight falling off in the demand for yellow prussiate of soda, but potash is scarce and higher prices are asked for near delivery. Tartaric acid continues in good request and a heavy premium is being paid for crystals on export account. Citric acid is only moving slowly. Higher prices are obtainable for cream of tartar and stocks are bare. Bichromates of potash and soda are still scarce and command high figures. Oxalic acid is very difficult to obtain and higher prices are paid chiefly for export. Makers of borax and boracic acid are well supplied with orders and are still considerably behind with deliveries. Phosphate of soda is in short supply but price is unchanged. The recent advance in lump salammoniac has checked business but makers are heavily booked for some time ahead in this and also in muriate of ammonia. The strong export demand continues for caustic soda and ammonia alkali. Bleaching powder is also in good request. There is little change to report in tar products. Pitch continues its upward tendency with a good demand but little is offering. Benzols are readily disposed of for motor fuel at current prices and the market is steady. Toluol is also steady. Solvent naphtha if anything is somewhat weaker for prompt delivery, but, although makers are disposed to accept lower prices for immediate, there is little offering for forward, higher values being looked for. Creosote is in good demand and some good business has been recently placed. Crude carbolic acid continues firm, only limited quantities being available. Liquid carbolic is unchanged, but crystals are scarce. There is no change in sulphate of ammonia, the production being readily disposed of.

A Disputed Potash Contract

IN the King's Bench Division on Monday, before Mr. Justice Bailhache, J. D. Pritchard & Co., Ltd., the Chemical Works, Crumlyn Burrows, Swansea, claimed £259. 11s. 8d. as damages for alleged breach of contract in relation to the purchase of 50 casks of carbonate of potash from S. Diamant, 51, Castellain Mansions, Elgin Avenue, London.

Mr. Morle, for the plaintiffs, said they were large manufacturers of oxalic acid and required the potash for the purpose of its manufacture. The defendant in October last offered plaintiffs 50 casks at £117 per ton as natural, purified Russian potash containing 96·50 per cent. potassium carbon. Mr. Davies, plaintiffs' secretary, agreed to pay £2,700 and, with the defendant, went to the London Docks, saw the stuff and arranged for it to be available for delivery to plaintiffs. The defendant now set up that there was a verbal agreement with Mr. Davies to take the whole lot he being quite satisfied with the goods, and that there was no warranty given at all. Counsel, however, said the warranty was contained in the correspondence which clearly showed that the potash was sold by the result of the analysis. When the bulk was analysed by the plaintiffs they discovered that the percentage of potassium carbon was only 78·3 per cent. In accordance with trade custom they paid £2,700, deducting the amount now claimed as damages. This amount was counter-claimed by the defendant.

Mr. Davies, the plaintiffs' secretary, gave evidence bearing out Counsel's statement and said that at the Docks he made no arrangement whatever beyond that with the port authorities.

Evidence as to the analysis of the sample and the bulk of the potash was given, Mr. Harrison, plaintiffs' analyst, stating that the sample sent was of high class.

Mr. W. R. Smith, analyst, said the bulk was ordinary commercial Russian potash. His analysis showed 78·3 per cent. potassium carbon.

Defendant, who denied in evidence that any warranty was given, in reply to his Lordship, said he had sent plaintiffs a telegram stating that adjustment would be made on analysis, but that was before he sold the goods at the docks.

His Lordship found for the plaintiffs with costs both on claim and counterclaim.

Rapid Oil Consumption

The United States Geological Survey announces that the United States is using twice as much petroleum as all the rest of the world, although its potential supplies are only one-seventh of the world's total. The other countries of the world are using about 200,000,000 barrels of oil yearly, and at this rate of consumption it is estimated that they have enough to last for 250 years. The United States, on the other hand, is using more than 400,000,000 barrels a year, and has only 18 years' supply. Fortunately, says the Survey, it is simply impossible to discover and take out the oil remaining in the United States in so short a period as 18 years. Americans are therefore warned that they must either depend to an ever increasing degree upon oil from other sources, or manage with less. As regards petrol, the motor cars and motor vans now in use in this country are consuming 25 per cent. more than last year, while production has only increased by 11 per cent. A shortage of petrol is predicted before the end of the present summer.

Catalogues Received

Grindley & Co., Ltd.

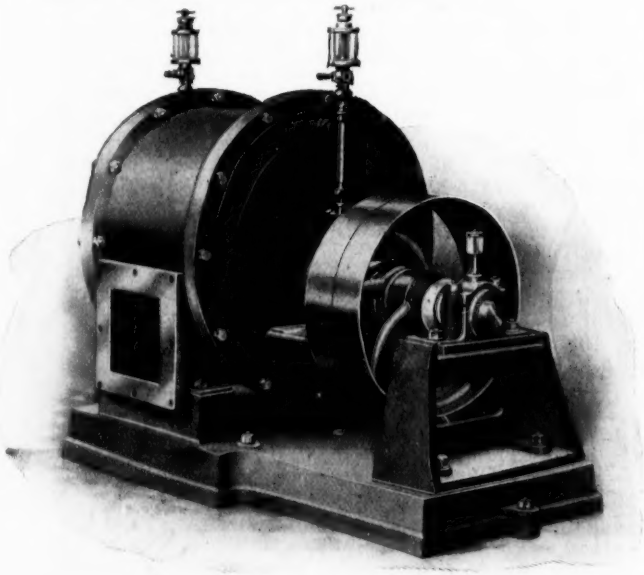
The oldest makers of paints, varnishes, &c., in Great Britain, this firm are well-known to the trade for the uniformly high quality of their goods which are manufactured at their works under the direct supervision of a staff of chemists. Among the specialities are Grindley's varnish gum preparations which are concentrated varnishes in paste form and only require melting at a low temperature and thinning with usually about an equal weight of turpentine or white spirit to produce high grade varnishes.—Poplar, E. 14.

Brotherton & Co., Ltd.

The uses of Formosul (pre-war German Rongalite) one of Brotherton's chemical specialities, are described in a "Formosul" booklet which the firm has just issued. The chief feature of Formosul is its enormous reducing power which renders it of special interest to calico printers, and in the direct printing of indigo, indanthrene and sulphur colours. It differs from Hydrosulphite in its reducing power in that it is quite an inert body at low temperature, and has practically no reducing effect at temperatures at which hydrosulphite already begins to undergo decomposition. The reducing action is only started by raising the temperature until near the boiling point of water, but at this high temperature it proceeds rapidly and very energetically. In practical application these properties permit of its being mixed with reducible bodies without having any effect on the latter at a moderate temperature; but by increasing the temperature the reducing action can be started at any moment, and its course can be retarded or hastened by means of suitable additions.—City Chambers, Leeds.

The Bryan Donkin Co., Ltd.

The advantages and features of the rotary blowers, compressors and exhausters of the positive type manufactured by this company for use in chemical, white lead, soap and oil refining works, &c., include simplicity of construction and small number of working parts, absence of all valves, silent working and the enclosure of all working parts.



Exhauster Driven by Fast and Loose Pulleys, Mounted on a Cast Iron Underbed, with outer Bearing and Pedestal.

The machines are claimed to be suitable for pressures up to 10 lb. per sq. inch, and are made in capacities varying from 100 to 500,000 cubic feet per hour. They are supplied for belt drive, or direct coupled to gas or steam engine or with electric motor. If required, however, the small sizes can be provided with hand driving gear. The back end plate is water cooled for moderate pressures, but for the higher pressures the shell also is water cooled.—Chesterfield.

The Aluminium Plant and Vessel Co., Ltd.

Although this company was formed only ten years ago, there is no branch of the chemical industry which is not familiar with its products. The loose-leaf illustrated catalogue contains a list of the principal manufactures for the chemical industry, together with tables giving details of the standard sizes, with their code words and reference numbers.

With regard to the aluminium nitric acid plant, it is stated that cold concentrated nitric acid has, for practical purposes, no action on the metal, while nitrous gases, when dry, are also without action. As the temperature and degree of the dilution rises, so does the attacking power of the acid, but solution is regular and therefore calculable, and for certain purposes it may still be profitable to employ aluminium for dilute and warm acid, as, for instance, in the case of inexpensive plant, such as syphons, &c. The plant for which aluminium lends itself more particularly in the nitric acid and explosive industries are:—Tank wagons, which are in successful use for the conveyance of acid by road or rail; stationary tanks for the blending of acids; storage tanks (under certain conditions); domes, hoods, junction pipes and vapour pipes for carrying off fumes; acid eggs; covers for earthenware vessels; drums for the transference of acid within the factory or by rail; syphons for dealing with small quantities of acid; nitric acid pumps, for filling carboys and many similar purposes; sundry small plant, such as rakes, tamping rods, shovels and tools of various kinds, bowls, &c.; pipe lines, which have proved very successful for transference of acid within the factory; and, finally, for the vast conduit systems used in the oxidation of atmospheric nitrogen. These have been very extensively adopted, and have proved signally successful. Aluminium is practically the only material within the reach of the manufacturer that not only fulfils the chemical but also the physical and mechanical requirements of such installations. Owing to the company's welding process, there is no difficulty in doing the work *in situ*.—Point Pleasant, Wandsworth, S.W. 18.

Ilford, Ltd.

The second edition of this firm's booklet "Panchromatism" (6d., post free 9d.) contains an interesting account of their panchromatic plates for colour photography, the characteristics of which are "their extraordinary colour sensitiveness, their freedom from fog, and the latitude in exposure they permit even when used with strongly coloured filters." The illustrations accompanying the letterpress show how much of the detail of a picture is lost in the use of the ordinary plate, and how successful the panchromatic plate is in recovering it. So marked is the difference in some cases that it is hardly possible to believe the object photographed is the same. The booklet not only explains the commercial advantages of the panchromatic over the ordinary plate, but gives an account of the process and of the research work which led up to it. This development of the photographic industry, like so many others, is closely allied with the dyestuffs industry. Certain dyestuffs, it is explained, have the power of conferring sensitiveness upon an ordinary photographic plate to regions of the spectrum in which these plates are otherwise quite insensitive. "Thus erythrosin, a bright pink dye, was found by Major-General Waterhouse to confer a pronounced degree of sensitiveness to the yellow green region. This dye is still in regular use for making so-called 'orthochromatic,' 'isochromatic,' or 'chromatic' plates; they are however not panchromatic because they are practically insensitive to red light. Many other dyes confer some degree of colour sensitiveness to a more or less limited region of the spectrum. The manufacture of commercially successful and truly panchromatic plates became possible only after the discovery by German chemists of the isocyanine dyestuffs. Thanks to the work of Sir William Jackson Pope and his assistants, several of these valuable dyestuffs are now made in this country and are placed unreservedly at the disposal of all, through the medium of Ilford, Ltd., The processes employed in the manufacture of panchromatic plates are either (1) to take finished ordinary dry plates and bathe them in a solution of the dyestuff, afterwards drying and packing them in almost total darkness or (2) to add the dyestuff to the liquid gelatine and bromide of silver emulsion before coating it upon the glass, afterwards drying, examining and packing the plates."—Ilford, London.

Company News

CAPE ASBESTOS.—An interim dividend of 3¾ per cent. per annum has been declared on the ordinary shares.

PARK GATE IRON AND STEEL.—A balance dividend has been declared of 1s. per share, tax free, making 1s. 6d. per share for the year ended March 31, 1920.

WHITEHAVEN HÆMATITE, IRON & STEEL.—A final dividend has been declared of 9 per cent., free of tax, on the ordinary shares for the year to March 31.

BRITISH OIL AND GUANO—The directors have declared a dividend for the past year of 7s. per share, free of tax (35 per cent., against 15 per cent. for the previous year).

SUN FUEL CO.—An interim dividend has been declared in respect of profits to March 31, 1920, of 7½ per cent (at the rate of 15 per cent. per annum) less tax, payable May 22.

MAZAPIL COPPER.—A further dividend has been declared of 15 per cent. (3s. per share), making 22½ per cent. for the year. After putting £30,000 to the debenture redemption fund, and £50,000 to reserve, £21,785 is carried forward.

NATIONAL PETROLEUM.—The profit for the year amounted to £16,268. After allowing £2,220 administration expenses from incorporation to December 31, 1918 (seven years and eight months), £4,000 to reserve for income tax, and £5,000 cost and expenses in relation to the Canadian oil and gas leases, £5,048 remains to be carried forward. The directors have decided to pay an interim dividend of 10 per cent. for the current year.

VAL DE TRAVERS ASPHALTE PAVING.—At the fiftieth general meeting held in London last week, Mr. T. Dryden Cooper (chairman of the company), presiding, a final dividend was declared of 9d. per share, making 1s. per share for the year 1919, less income tax, payable on and after May 8.

NEW ZEALAND COAL AND OIL.—The accounts for the year to February 28, 1919, show a profit of £2,897, and £17,780 was brought in, making £20,677; after deducting £7,779 for depreciation of plant, machinery, and buildings there remains a credit balance of £12,898 to be carried forward.

APEX (TRINIDAD) OILFIELDS, LTD.—The issue is announced of 200,000 £1 shares of this company (all underwritten) at £1. 5s. per share; of these, 50,000 are being subscribed firm by the underwriters, and the remaining 150,000 are offered for subscription through the London Joint City and Midland Bank. Applications from existing members of the Apex (Trinidad) Oilfields, the Anglo-French Exploration Co., and the British-Borneo Petroleum Syndicate will be given special consideration. The Apex (Trinidad) Oilfields, Ltd., was formed primarily to develop and operate oil-bearing lands in Trinidad.

CHERSONESE (F.M.S.) ESTATES.—The profit for the year ended December 31 was £67,234, against £28,667 in 1918. The amount brought forward was £4,452, less excess profits duty for 1918, £3,894, making a total available of £67,791. A first and final dividend has been declared of 20 per cent. being 4 4-5d. per share (against 12½ per cent last year), leaving to be carried forward (subject to excess profits duty estimated at £17,500), £22,791.

ANTON JURGENS' UNITED (MARGARINE) WORKS.—It is proposed to pay a dividend of 25 per cent. (against 15 per cent.) on the ordinary shares Nos. 1-16,513, and 12½ per cent. on the Ordinary shares Nos. 16,514 to 32,627; also an extra dividend of 1½ per cent. on the six per cent. cumulative participating "B" Preference shares and 3 per cent. extra dividend on the six per cent. "C" Preference shares. The carry-forward is £335,802.

BRYANT & MAY.—For the year to March 31 last the net profits, after providing for debenture interest, depreciation, &c., amount to £201,642, and £19,599 was brought in, making £221,241. Interim dividends were paid last November on preference shares at the rate of 14 per cent. per annum £33,600, and on ordinary shares at 4 per cent., free of tax, £32,000, leaving available for distribution £155,641. The directors place to reserve fund £20,000, and recommend further dividends and proportion of profits to employees—on preference shares at the rate of 14 per cent. per annum, £33,600, and on ordinary shares, 4 per cent., free of tax, £32,000; under Brymay co-partnership—3 per cent. on ordinary shares, free of tax, £24,000; employees' proportion £24,000; carrying forward £22,041.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette

Partnerships Dissolved

HOLLIS, STEPHEN, and YEO, HENRY, trading as oil merchants and blenders, at 2, Midghall Lane, Liverpool, under the style of The National Lubricant Co., by mutual consent, as and from April 24. All debts received and paid by Henry Yeo.

BOOTH, ALBERT EDWARD, 22, Georgiana Street, Moses Gate, near Bolton, Lancs., and LOMAX, ERNEST, 610, Bury Road, Breightmet, Bolton, carrying on business at 610, Bury Road, under the style or firm of The Wearwell Varnish Co., by mutual consent, as and from April 24, 1920. All debts received and paid by Albert Edward Booth.

WOODLEY, RICHARD, and BURR, THOMAS WILLIAM, tar distillers, firelighter manufacturers and dealers in fireclay goods, Thorne, Yorks., under the style of Woodley & Burr, by mutual consent as from September 11, 1919. All debts received and paid by Thomas William Burr, who will continue the business.

Liquidators' Notices

GHIZELA NITRATE CO., LTD. (in liquidation).—A general meeting of members will be held at Baltic House, 27, Leadenhall Street, London, E.C., on Friday, June 4, at 12 noon. W. J. Welch, Liquidator.

GLAMORGAN CHEMICAL CO., LTD.—A meeting of creditors will be held at the offices of Gwynne & Co., Ltd., Briton Ferry, on Wednesday, May 12, at 2.30 p.m. E. E. Hill, Liquidator.

PREMIER OIL & PIPE LINE CO., LTD.—A general meeting of members will be held at 2, Gresham Buildings, Guildhall, London, on Wednesday, June 9, at 11 a.m. H. J. de C. Moore, Liquidator.

Companies Winding Up Voluntarily

PETROLEUM COMPANY OF ILDOKANI, LTD.—A meeting of creditors will be held at 638, Salisbury House, London, on Thursday, May 13, at 11 a.m. F. F. Fuller and O. Tchighianoff, Liquidators.

P. R. T. COPPER WORKS, LTD.—A meeting of creditors will be held at 36, King Street, Cheapside, London, E.C.2, on Monday, May 17, at 4.30 p.m. Creditors' claims on or before June 30 to F. H. Christlieb, Liquidator, at the above address.

Notice of Dividend

BLACKWELL, RICHARD G., 5, Hornby Road, Old Trafford, Manchester, representative of a chemical company. 20s. first and final. May 7, Official Receiver's Offices, Byrom Street, Manchester.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, created after July 1, 1908, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges which would, if created after July 1, 1908, require registration. The following Mortgages and Charges have been so registered. In each case the total debt, as specified, in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.*]

ASPINALL'S ENAMEL LTD., LONDON, S.E.—Registered April 21, £30,000 debentures secured by Trust Deed dated April 9, 1920; general charge and by Trust Deed, property and land at New Cross, Peckham and Mitcham. *£25,000. March 29, 1920.

BRITISH OIL & TURPENTINE CORPORATION, LTD. (formerly BRITISH TURPENTINE CORPORATION, LTD.), HAYES.—Registered April 23, debenture securing all moneys due or to become due, to Barclay's Bank, Ltd.; general charge. *Nil. March 5, 1920.

HENSBARROW UNITED CHINA CLAYS, LTD., LONDON, E.C.—Registered April 20, £50,000 debentures (filed under sec. 93 (3) of the Companies (Consolidation) Act, 1908), present issue £43,000; general charge, subject to prior charge. *£50,000. December 31, 1919.

LONDON LUBRICANTS (1920), LTD., LONDON, E.—Registered April 21, £10,000 debenture (and further advances), also charge under Land Transfer Acts securing £10,000, to British Trade Corporation, 13, Austin Friars, E.C.; charged on property at Old Ford, also general charge.

WESTERN COUNTIES CLAY CO., LTD., ST. AUSTELL.—Registered April 20, £8,000 (not ex.) mortgage, to Lloyd's Bank, Ltd.; charged on premises at Greensplat, St. Austell.

Satisfactions

DUNSTABLE LIME CO., LTD.—Satisfaction registered April 24, £3,900, registered February 19, 1913.

LUBRICATORS, LTD., LONDON, N.—Satisfaction registered April 27, £8,000, registered November 13, 1915.

County Court Judgments

[*NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court judgments against him.*]

TONGUE, ALBERT JAMES, 16, Millbrook Road, Southampton, chemist. £21. 13s. March 15.

BENSON, RACHEL ROSELLA, 15, Queen Street, Wigan, manufacturing chemist (trading as the General Chemical Co.) £19. 7s. 6d. March 4.

ROBINSON, LESLIE, Netheravon, chemist. £10. 6s. March 11.

Chemical Works Engineering

AT a meeting of the Chemical Section of the Manchester Literary and Philosophical Society last week, a discussion on "Engineering as Applied to Buildings and Plant in Chemical Works" took place. In opening the debate, Mr. John Allan, F.C.S., stated that the engineering knowledge involved in connection with chemical works was very often of such a type that it might easily be within the province of a specialised civil engineer. In selecting a site for the erection of heavy buildings, it was obvious that knowledge of the suitability of the ground for carrying such buildings was essential. Although not quite so obvious, it was also necessary that attention should be paid to the question of the effect of the soil upon metals which might be embedded in it or of waste liquors which might find their way into the soil by diffusion. Whilst being a satisfactory material for the construction of buildings generally, ferro-concrete was not satisfactory in connection with chemical plant, the material not lending itself readily to the removal of pipes and other parts of plant, an operation which was frequently necessary. Another important point was that all parts of chemical plant should be readily accessible in case of repair work being called for, and in the lay-out of a plant this matter should be accorded adequate consideration. Whilst deprecating the policy of installing tanks and pipe lines below the ground level, Mr. Allan stated that where this course was unavoidable, they should be placed in a well, sufficient space being allowed to permit a man to move freely around them for observation purposes. By reason of the saving in expenditure on drawings, patterns, &c., and the less serious effect of breakdowns, the unit system of plant construction was said to be frequently profitable. Such a system would be greatly facilitated by standardising the construction materials. In conclusion, Mr. Allan referred to the centralisation of power units and steam supply, and, where possible, the grouping of buildings in which particular operations were carried on.

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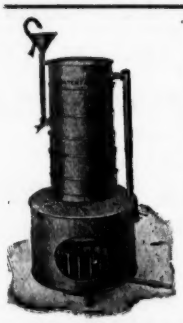

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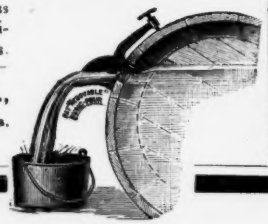

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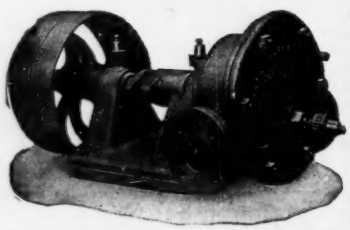

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